THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. CXII. No. 2482.] LONDON, DECEMBER 6, 1910. [62ND YEAR. PRICE 6d.

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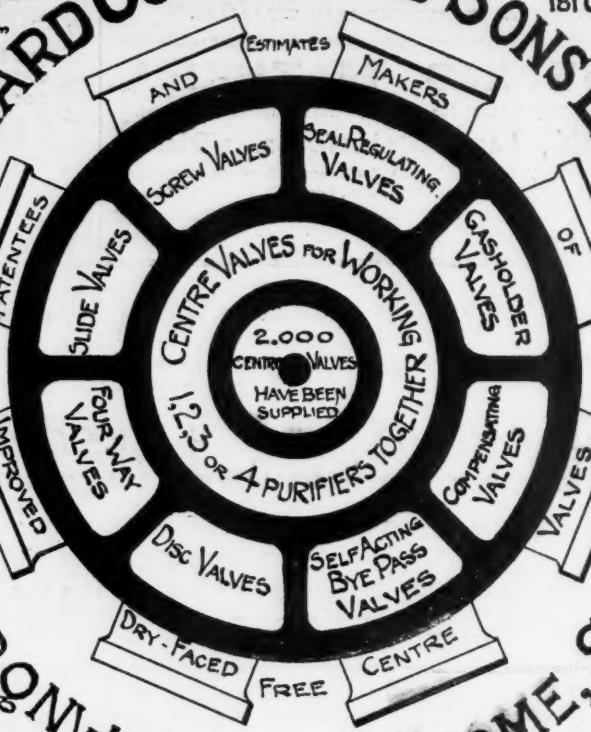

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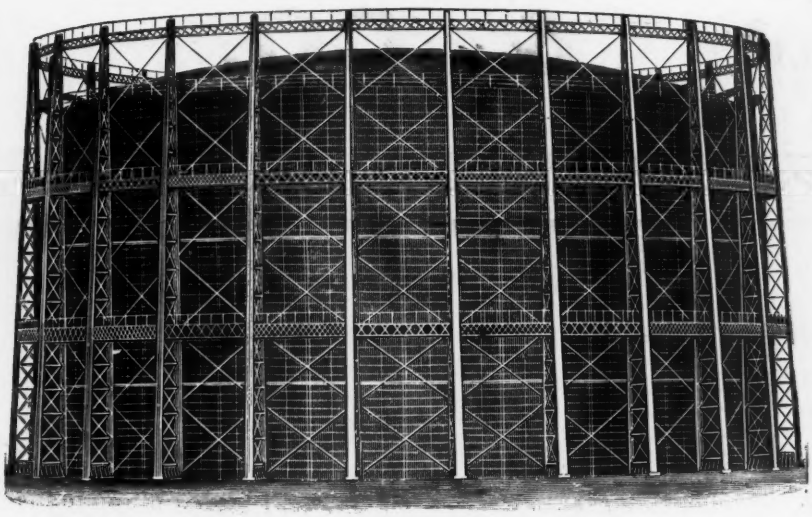

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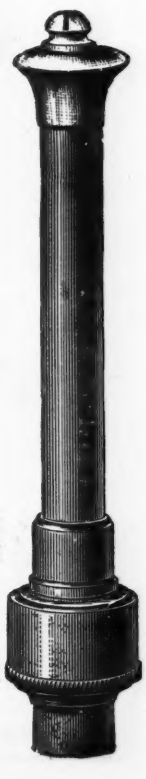

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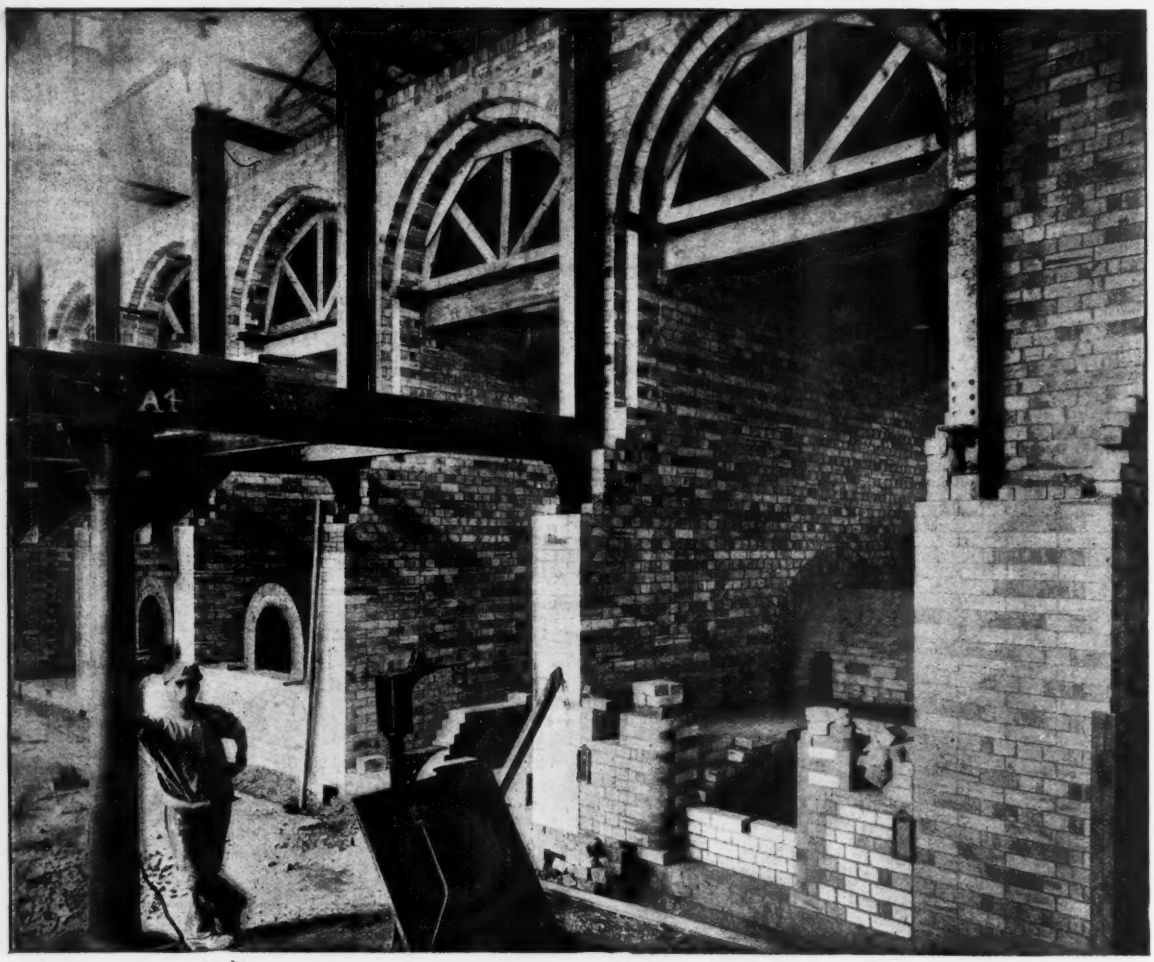

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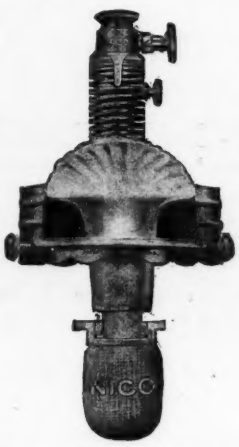

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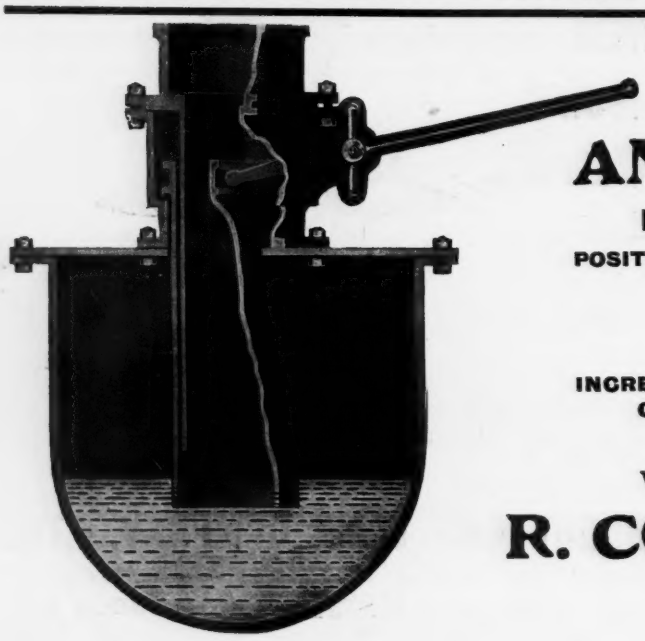

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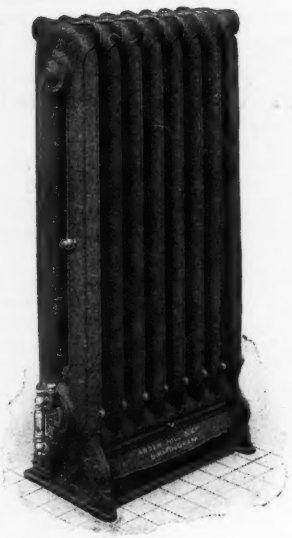

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Long life and hygienic value are ensured.

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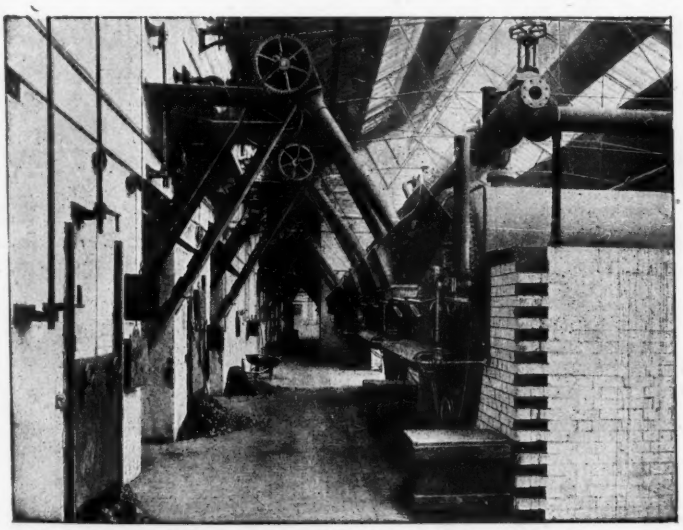

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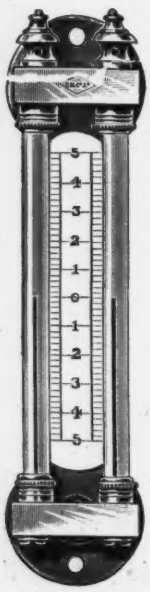

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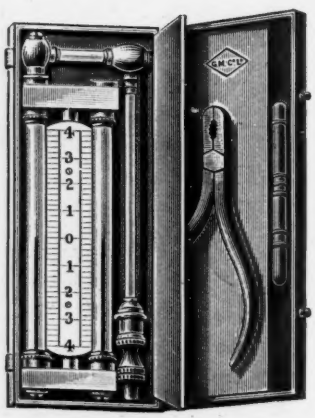

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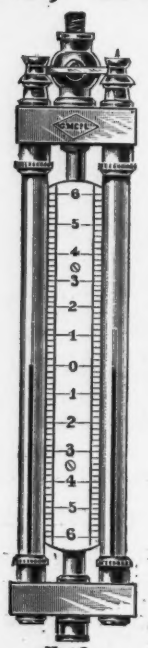

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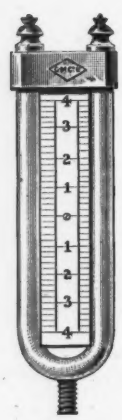

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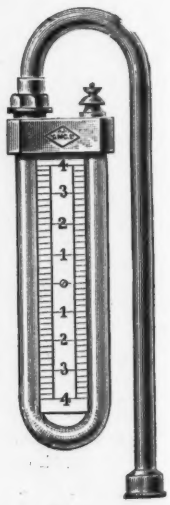

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which are the 'Acme of Perfection' in inverted burners, because they possess all the advantages, but none of the disadvantages, of brass burners—

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Fitted with **hinged head**, giving ready access to the adjustments.

Constructed of Strong Steel Plates and finished in Dark Green Vitreous Enamel, with White Enamelled Stays.

Can be supplied with all Copper Casing at extra cost.

Supplied with Cast-Iron Frcg with Bolts for fixing to 3-in. Spigot.

Height overall 40 ins. Reflector (convex, to distribute over wide area) 21 ins. diameter.

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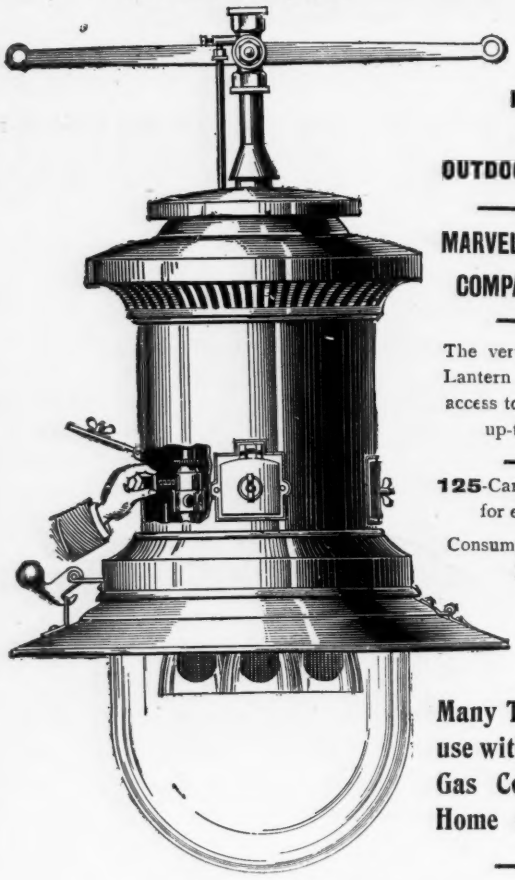

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Consumption, 4 ft. per Burner

Many Thousands in use with the largest Gas Companies at Home and Abroad.

"INDOOR Lamps."

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Full Directions for use sent with each Lantern.

Highest grade black enamel finish Lanterns, priced complete with "Venus-Cyclop" XX Mantles, Jena inner Chimneys, best Imperator Quality Globes.

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G9031.	2-Light,	250 Candle-power, ⅜ in. Inlet, 17 in. Reflector, 24 in. Overall, **45/-** each.
G9032.	3-Light,	375 Candle-power, ½ in. Inlet, 17 in. Reflector, 27 in. Overall, **57/-** each.
G9033.	4-Light,	500 Candle-power, ½ in. Inlet, 19 in. Reflector, 31 in. Overall, **75/-** each.
G9034.	5-Light,	625 Candle-power, ½ in. Inlet, 19 in. Reflector, 33 in. Overall, **88/-** each.

Highest grade white enamel finish Lanterns, priced complete with "Venus-Cyclop" XX Mantles, Jena Inner Chimneys, Best Imperator Quality Globes.

G9035.	1-Light,	125 Candle-power, ⅜ in. Inlet, 14 in. length Overall, **25/6** each.
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Upright and Inverted "VENUS" Mantles

ARE STILL THE BEST.

Require also no extravagant statements for selling purposes.

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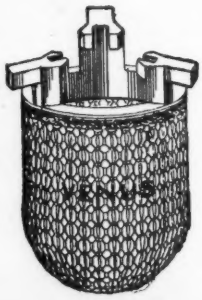

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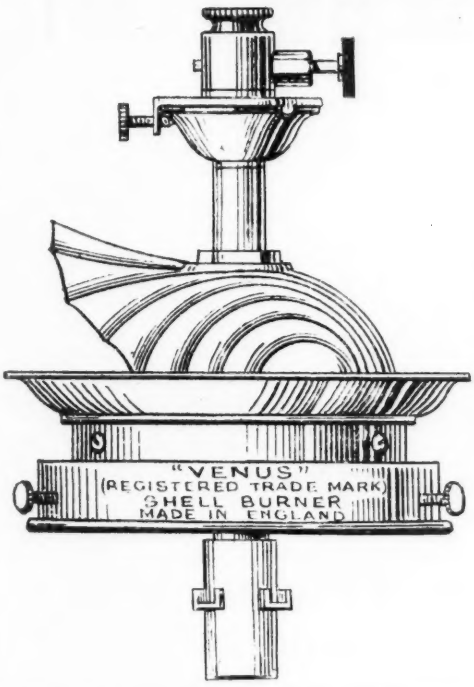
Venus "SHELL" Burners.



NOTICE.

IN order to allay doubts which appear to exist as to my right to sell these burners, I desire to call attention to the fact that in an Action brought by me against the Bland Light Syndicate Ltd., entitled "In the High Court of Justice, Chancery Division, Mr. Justice Warrington, B. Cars and The Bland Light Syndicate Ltd., 1910, C. No. 67" Mr. Justice Warrington granted a PERPETUAL INJUNCTION restraining the Bland Light Syndicate Ltd. its Directors servants and Agents from making or publishing statements or communications to my customers or purchasers or others calculated to prevent prejudice or damage or in any manner interfere with the sale by me of gas burners or any other articles and goods manufactured imported sold or dealt in by me and he also granted a PERPETUAL INJUNCTION against the Bland Light Syndicate Ltd. restraining them from threatening or continuing to threaten myself or my customers or any other person or persons with legal proceedings or liability by circulars advertisements or otherwise in respect of the alleged infringements of any Letters Patent possessed by the Bland Light Syndicate Ltd. in September and October 1909.

The learned Judge also awarded me £50 DAMAGES and the COSTS OF THE ISSUES upon which I succeeded.

B. CARS.

December 1st, 1910.

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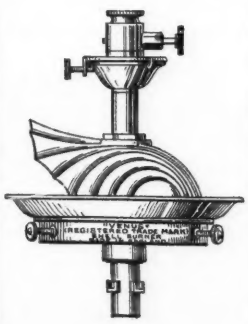

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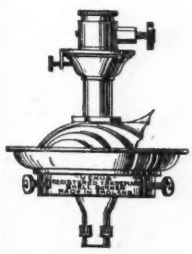

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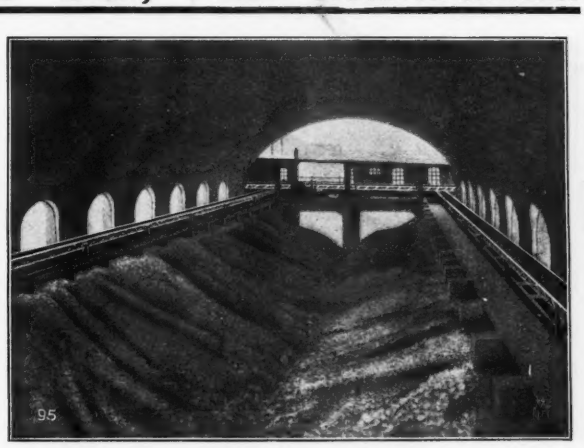

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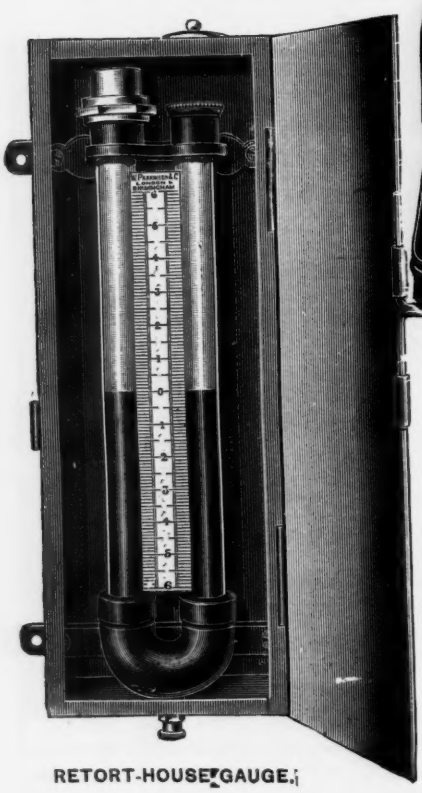

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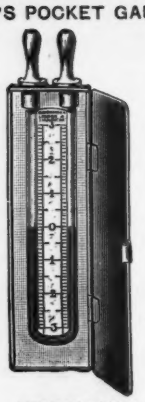
Fig. 6.



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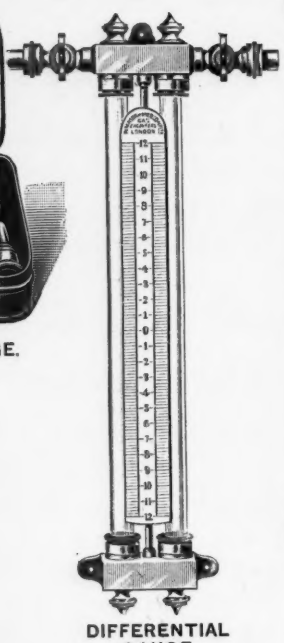

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Fig. 5B.

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VOL. CXII., No. 2482.—TUESDAY, DECEMBER 6, 1910.

EDITORIAL NOTES—GAS, &c.

Thirty Years Ago.

IT has been said on more than one occasion in these columns that an acquaintance with the long-past history of the technical and commercial affairs of the gas industry enables one the better to understand and appreciate the vast changes in thought, opinions, and practices that have passed over and through the industry, and assists in bracing one's optimism regarding the prospect as surveyed from the standpoint of current time. A few days since, turning over the pages of the first volume of the "JOURNAL" for 1881 in search of a matter altogether disconnected from carbonizing, the eye alighted on, and was arrested by, this sentence in an editorial article, dealing with the proceedings at a meeting of the South Metropolitan Gas Company, published on March 1 in the year named: "Mr. E. Horner sharply criticized the "working results of gas made per ton of coal carbonized." Reading on, it was learned that—

The proprietors declined to take fire even at Mr. Horner's startling statistics of the many thousands of pounds which he suggested were wasted every year in consequence of Mr. Livesey's deliberate choice of a medium, instead of a high, yield of gas from the coal carbonized. . . . Mr. Livesey was not able to flash such dazzling considerations before his hearers as had been brought forward by Mr. Horner; but although his argument was necessarily somewhat technical, it clearly showed to the mind of the most inexperienced person present at the time, that that gentleman's assumption that the extra yield of gas which he so much admired could be obtained without extra expense was a fallacy.

Those final words have a peculiar interest about them with the accounts of the Company facing us for the past two or three years, in which the extra quantity of gas produced per ton of coal, with the consequent saving in coal and in manufacturing expenses, has made a remarkable difference in the financial aspects of the periods to which they refer. But looking at the position then from the point of view of the present, it must not be imagined that the Mr. George Livesey of that time was not just as much a progressive in technical and commercial affairs as the Sir George who led with such spirit and dogged determination in the subsequent years in the cause of the progress and the stability of the gas industry. That it was considered to be a fallacy that an extra yield of gas could be obtained without extra expense thirty years ago, was due partly to the reigning circumstances and restrictions, and partly to the position of the knowledge of the time; and Mr. Livesey was then quite right in maintaining that, in the case of his Company, the extra cost of a different kind of coal that would have been necessitated to maintain the 16-candle gas standard with a higher yield per ton would have meant the sacrifice monetarily of all the advantage of the additional quantity of gas that there would have been for sale per ton of coal. Mr. Horner was making comparison at the time with the working of the Gaslight and Coke Company, who were supplying partly cannel gas in Westminster, and were using some of the expensive material for enriching the ordinary supply, with the result that they were making 500 cubic feet of gas per ton more than the South Metropolitan Company, but were paying a large average price per ton for coal used. Taking this extra make of 500 cubic feet per ton, Mr. Horner calculated that, on the production of the latter Company, it represented 10,000 tons of coal in a half year, and that, taking together the cost of coals and that of carbonizing this quantity, it would mean £8000 to £9000 in the six months. The argument was plausible enough so long as losses and gains under the conditions of the time were not set one against the other, and a balance struck in order to ascertain on which side right and profit were to be found.

Those were days in which carbonizing questions were much to the fore among gas technicians, just as they are to-day. The adoption of generator and regenerative settings was at the time a polemical subject in our columns; and ideas were then in a somewhat unsettled condition. It was readable intelligence then that generator or regenerative settings were being applied at such and such works; just as it is to-day to learn where vertical retorts are being installed. Before the meeting referred to of the South Metropolitan Company, there appeared in the same volume a reproduction of a drawing of the (at that time) new regenerative settings that Mr. Livesey had designed for the Old Kent Road works. The progressive instinct was always very strong in the then Chief Engineer of the South Metropolitan Company. But, regarding the question of higher makes, those were the days of luminosity by combustion without the use of the ancillary mantle; and we find him then saying: "I have gone very "carefully into the question of a large make of gas per ton "of coal; and I am prepared to state that, when you have "to supply 16-candle gas, by increasing the make per ton "of coal beyond about 9800 cubic feet, you impoverish the "gas, and have to use more cannel; and every ton of cannel "the Company use is a decided loss." That reflects the position of knowledge at the time. Advance had not then been made to a comprehension of the benefits of heavier charges, with less free space in the retorts, and longer duration of carbonization. There was a rooted belief in a good free space above the charges in the retorts. Knowledge has altered opinions, and has so changed conditions that the theories and the practices of thirty years ago are not the theories and practices of to-day. What were the facts of thirty years ago, however, were not such stubborn things that they refused to fall, and to be replaced by others set up by fresh knowledge and experience.

With the establishment of the mantle, new views drove the old ones from the mind of the chief at Old Kent Road; and right to life's end new ideas superseded former ones in conformity with changes of condition that were introduced with advancing time. *Tempori parendum.* To no man does the industry owe so much as to Sir George Livesey for initiative work, and for leading in the fight to reduce those restrictions that would, had they continued to survive, have crippled seriously the benefits derivable from current knowledge. It is interesting to look back in this matter, and to remember these things—more especially when an accidental circumstance reminds of views held in the deep past by one who occupied the prominence of Sir George in both the technical and commercial history of the gas industry, and who lived fighting so strenuously for its liberties in the service of the public. But the views as to make per ton in relation to illuminating power held sway in practice until 1901. The 9800 cubic feet make of 1881 was the make within a few feet per ton until 1901, when the fight for a reduced standard of illuminating power brought about the institution of the 14-candle standard south of the Thames, in place of the 16-candle one. The following year the make per ton was up to 10,434 cubic feet. The next year, it averaged 10,715 cubic feet, in the proximity of which figure it remained until 1906. Then in the year, 1907, the average production was 11,138 cubic feet; 1908, 11,386 cubic feet; 1909, 11,499 cubic feet; and the first half of this year, 11,820 cubic feet —2000 cubic feet beyond the figure above which thirty years ago Mr. Livesey declined to go with 16-candle gas on account of the impoverishment of the gas through conditions of carbonizing knowledge and practice at the time. Only at the last half-yearly meeting of the proprietors of the Company, the successor of Sir George (Mr. Charles Carpenter), in his address from the chair, mentioned that the quantity of gas sold per ton of coal carbonized had been increased to the substantial figure of 11,543 cubic feet; whereas ten years ago the amount was only 9300 cubic feet. Mr. Horner, who had considerable knowledge of gas affairs in his day, thought that 10,200 cubic feet per ton was a high make. Had he been alive now, what would he have said to 11,800 cubic feet?

This peep into the past, in regard to carbonization and gas make, shows not only how vastly views and practices and results have changed, but it also illustrates how, in the case

of the gas industry, there has been a hampering of progress by restriction. Statutory and arbitrary have been largely synonymous terms in respect of the restriction under which the gas industry has laboured in the past; but things are getting into a little more orderly condition now. And during the years that restriction has been lessened, the internal working of the gas industry has been on a plane of economy never reached before. From the point of achievement, there will be no turning back.

The Confirmation of Carbonizing Theory.

The lecture that Dr. Harold G. Colman delivered at the Manchester University last Saturday afternoon on coal carbonization for gas production will stand on record as not the least in value of the series that has tempted so many gas men (young and otherwise) to abandon recreation for study on one Saturday afternoon each month so far this winter session—a point which Mr. Dugald Clerk a few days since personally told us struck and greatly pleased him, as a sign of the times in the gas industry, on the occasion of his lecture at the beginning of last month. That by the way. Dr. Colman's subject was a big one; and had he ventured to embrace the whole by a mere outline in a single lecture, it would have been an unprofitable exercise. Capable as he is of dealing with the mechanical and economical aspects of the question, he did well, therefore, in confining himself to its chemical side, in which he is, as one of the really few masters, so much at home. To any student of such a subject, it is an enjoyable treat to be led from theory to theory by the master hand until brought to the stage where it is shown that modern systems and practices give as full effect and practical embodiment to those theories as, within the limits of our knowledge, is possible. At the same time, we have to confess that the information is very imperfect as to what occurs—and what occurs is wonderful—inside a gas-making retort, though many among us have often, in the desire for fuller information, taken the long-since tendered advice of Mr. Thomas Newbigging to project ourselves in thought into a retort to ascertain what is going on there. Imperfect knowledge notwithstanding, that the theories as presented in the lecture are well founded is borne out by the results of the modern practices that incorporate accepted principles of design and method. That is what Dr. Colman, stage by stage, illustrated to the students of carbonization; and all gas engineers young and old must continue in this category while knowledge is incomplete.

It is always, whatever the work in hand, well to have an ideal at which to aim. In the process of making gas, we are afraid that, in the main, the only ideal that numbers of gas engineers and managers have any reverence for is the standard illuminating power of their gas. Were it not for the legislative propping up of illuminating power as the standard quality of gas supply, the ideal to work to in carbonization would be, in the interests of the public and the industry itself, the one (succinctly stated by Dr. Colman) of obtaining the maximum proportion of heat units at low cost in the form of combustible gas, with the proviso that the gas should only contain a limited quantity of inert gas, and that, as far as practicable, it should be of uniform composition and calorific power. That is the ideal; and if we were at liberty in this country to adopt it *per se*, there would not only be relief to the responsible gas maker, not only would the quality forming the base of the standard comply with the major use of gas to-day, but there would be a broadening out of the opportunities of the gas maker in the economical purchase of coals through the abandonment of the present necessary consideration as to their sperm value. At the present time, this consideration has to be retained prominently in view. But there is gratification in the knowledge that, in the horizontal retort, heavier and longer duration charges (though the weight carbonizing capacity per day is somewhat reduced) give a higher yield in combustible gas of B.Th.U's. than was formerly the case; and the same applies to the vertical retort systems.

This is highly satisfactory, as though the retention of the illuminating power standard is a material hindrance to the most effective work in the production of carbonizing results, it shows that, the drawback notwithstanding, the gas industry is not debarred from realizing a large proportion of the manifold advantages presented by the practices approved by the highest carbonizing competence of the times—carbonizing in vertical retorts, or in horizontal retorts with a small free space at top. The advantages, putting them generally, are: A larger make of gas, with a greater calorific yield in gas per ton of coal, improved coke, thinner tar containing less free carbon, reduced amount of carbon bisulphide, and less naphthalene, without mention of working economies which formed no part of the lecture. The free space with high temperatures in the old method of working with horizontal retorts has much to answer for in depreciating the results of working. Experience has taught us—and this experience only came with the vertical retort—that the desirable method of carbonization for gas making is one by which (to quote Dr. Colman's own words) "the coal "itself can be heated to a high temperature, without simul- "taneously causing a too great heating of the volatile pro- "ducts." The vertical retorts and heavier charges in horizontal ones produce this condition by eliminating entirely in the one, and nearly so in the other, the free space; and this elimination is the essential escort of high temperature carbonization.

Considerations such as these led to the statement of an interesting hypothesis by Dr. Colman, as to the travel of the gas from the charge in a vertical retort—say, an intermittently charged one. He suggests that, as carbonization proceeds, there is a pasty wall formed between the outer vertical carbonized portion and the inner uncarbonized core, which prevents the gas from the latter passing through to the hot coke, and the remaining gases in the coke passing into the core of partially carbonized coal. Therefore, part of the gas ascends through the coke, and part of it through the uncarbonized core. There would be some difficulty in quantitatively determining the proportions travelling through the two passages; but Dr. Colman ventures to suggest that probably half goes one way, and half the other. On *à priori* considerations, we would submit that he is giving too much to the coke. The greatest evolution of gas from any given part of a charge of coal is at the commencement of its carbonization. We start with a completely uncarbonized charge; and the first large evolution goes on continuously from the outer edge to the inside. Accepting Dr. Colman's hypothesis, there is the pasty division wall that prevents this gas finding any other escape than through the path of least resistance, and that path is the uncarbonized core. The outer carbonized portion of the charge is but a gradually increasing quantity, and surely there cannot be sufficient gas left in it, after the formation of the pasty seal, to account for half the entire production of gas having to take its passage through the incandescent coke. But whatever is said on this point must be more or less mere deduction from a consideration of the known actions occurring in carbonization; and therefore we will adopt Dr. Colman's caution, and refrain from setting up our suggestion as being any more worthy of acceptance than his.

It was a really good lecture—a lecture cohering stage by stage from theory to practice and results; and every word that was said in praise at the close was richly deserved.

The Repentance of Liverpool.

Corporation Adopt "Metropolitan" No. 2 Burner for Fazakerley.

We cannot refrain from making a point of the latest phase of the attitude of the Liverpool Corporation towards the "Metropolitan" No. 2 standard argand gas-burner, with the history of the acrimonious and expensive opposition to the Standard Burner Bills so fresh in mind. From the early stages, the Corporation took the lead in organizing hostility; from the same quarter no opportunity was lost at any stage in trying to destroy the measures and causing their detention in progress; and at the penultimate stage, there were attempts being made to produce a wreck, when various differences between the Gas Company and the Corporation were composed. The result was the latter withdrew from further participation in the strife that they had been so largely instrumental in stirring up; and the opposition collapsed like a house built of a pack of cards. The *dénouement* is before us. The "London Gazette" published last Tuesday contained a notice by the Liverpool Corporation of their intention to apply to the Local Government Board next session for an Order to empower them to adopt the "Metropolitan" argand burner No. 2, or any other burner which the Local Government Board or the Board of Trade may approve under the provisions of the Order, as a standard burner in substitution for the burner now in use for the official testing of the illuminating power of gas supplied by the Corporation in the parish and township of Fazakerley. The announcement is brimful of interest; but we do hope for the peace of mind of the Corporation that the Local Government Board will not now read the evidence that was

submitted last session in the name of the Liverpool Corporation as to the wicked and mischievous effects upon gas consumers of adopting the burner which it is desired to apply to the Corporation's own gas supply.

But we will not irritate old sores. The Corporation are doing the right thing; and no doubt under good advice. Mr. Isaac Carr is the Consulting Engineer of the Corporation in connection with their new gas-works for the supply of the Fazakerley district; and he designed and put them in possession of a works on as economical lines as any of which we know, considering site conditions and the fact that much of the plant is of an order that will enable the capacity of the works to be considerably enlarged at a very cheap rate. If it is on his advice that the Corporation are now, after all that has transpired, adopting as a test-burner the "Metropolitan" No. 2, the wisdom of the recommendation will not be questioned by any professional man in the industry. At the present time, the gas at Fazakerley is of illuminating power, and tested by the flat-flame burner, precisely as in the case of the gas supplied by the Liverpool Gas Company. It may be that a desire to keep things uniform in these respects throughout the city's administrative area is the reason for the proposal before us. Uniformity of gas testing is one of the points in the case for the universal application of the "Metropolitan" No. 2 burner. The present action of the Liverpool Corporation is certainly the most enlightened they have taken in connection with gas testing during the past twelve months.

The Electrical Art of Falsehood.

THE campaign of falsehood and calumny against gas continues in the advertisements of the electricity supply industry; and the case for the inauguration of the activities of the Gas Publicity Committee strengthens and gets more urgent each passing day. Of course, the great extent of public experience in the use of gas gives the lie direct to the false statements of those writers of advertisement literature who are paid by electrical money for their dishonesty. But public experience is not sufficient to counteract the electrical mendacity circulated in the way of advertisements in the public press. Gas undertakings, it is true, are spreading their business in both cooking and heating at a remarkably healthy rate. But it is the duty of the industry as a whole to, for protection, destroy by any means that is fair and open every check that is attempted on the part of the competitors, and not sit by supinely while the campaign proceeds, or leave the task of meeting it to the enterprise of individual concerns.

Take a single page of the "Pall Mall Gazette" for Nov. 30. Two of the central columns were occupied by advertisement articles, one headed "The Advance of Artificial Heating," and the other one "Up-to-Date Cooking by Electricity." Among the statements in the article dealing with gas heating is one which asserts that "of the amount of gas "purchased, only 18 per cent. actually heats; the re-"maining 82 per cent. disappears in fumes and carbon." Practically the same statement appears in the article on cooking; and in both instances it is maliciously defamatory. Then there is a quotation from the annual report of the Chief Inspector of Factories as to the percentage of carbonic acid found in workrooms said to be due to—not to the number of human beings congregated in ill-ventilated rooms, but to badly ventilated gas-stoves, or to gas-jets lighted for the purpose of raising the temperature of the rooms. This is a matter that was dealt with in our columns at the time of its publication. Further we read that "elec-"tricity in the bath-room is a rare acquisition; being far "better than fumes of gas or other heating." The points as to the small proportion of the heat of gas that is usefully employed and as to the contamination of the atmosphere are answerable by the reports on the gas-heating tests scientifically carried out at the Leeds University; and the columns of the "Pall Mall Gazette" are no doubt just as open to the Gas Publicity Committee for the circulation of the contradiction on the same terms as to the Electricity Publicity Committee for the dissemination of the slanderous statements. In the advertisement-article on cooking, "considera-"tion" is given to the "enormous advantage electricity as "a cooker has over gas;" and among the misleading statements are these: "There being no fumes, all the food re-"mains pure; and the cook is not subjected to the unpleasant "and poisonous gas associated with gas-stoves and coal "fires. . . . As the jets are necessarily placed at the bottom "of the gas-oven, and the heat ascends, all the food placed "within for cooking must necessarily become contaminated "with carbon." It would be interesting if the electrical people would favour us with more definite information on this point, in place of the vague and foolish statement. On the very same page of our evening contemporary there is an advertisement which declares that "Osram Lamps make "Electricity Cheaper than Gas."

Work for the Gas Publicity Committee presses in administering the antidote to the poisonous misrepresentations of (we take it these advertisements emanate from them) the Electricity Publicity Committee; and, bearing upon the advertisement articles to which attention is called, there are points as to the heating capacity of electricity and other matters on which information may be published in the cause of the propagation of useful knowledge among the electrically unenlightened section of the public. But if the slanderous work that is proceeding from the other side wants to be supplemented in order to stimulate the gas industry to prompt activity in these matters, perhaps it will be supplied by the information that, at a joint conference of London Electric Supply Authorities on Thursday last, it was decided to subscribe a substantial amount to the funds of the Electricity Publicity Committee, on a revenue basis, for the purpose of the development of a still more vigorous advertising programme. On the same occasion, a resolution was passed expressing appreciation of the work of the Committee; so that it is clear the electric supply authorities approve of a policy of circulating maliciously defamatory, untrue, and misleading statements concerning gas.

Gas Provisional Orders.

THE report of the Board of Trade on the Gas Provisional Orders of the past session is, as usual, of somewhat commonplace order; but its chief value lies in the confirmation of the current trend of gas legislation in all quarters. It is gratifying to find that so many non-statutory undertakings take advantage of the Gas and Water Works Facilities Act, 1870, to obtain parliamentary authorization; and the same thing will be happening in the next session. In the past session, of fifteen gas companies making application for powers, no less than nine were in respect of non-statutory concerns. Two of the Orders were withdrawn—Sudbury and Dunblane. Among the special clauses appearing in the Orders were an allowance of 4d. extra upon the price of gas in an extension of area obtained by the Swansea Gas Company; while in the Dinnington Order the price of gas for public lighting was limited to 3s. 6d.—the standard price, with sliding-scale, being 4s. The fixing of a maximum price for gas used for public lighting, or provision that gas so consumed shall be at no higher rate than the lowest price charged to any consumer for lighting purposes, is still occasionally seen—the old clause providing for the equivalent of the lowest charge without specifying purpose being one which, in these days of reduced charges for power and industrial purposes, and in some cases for heating, there is a greater desire to amend than to perpetuate or to adopt. Such a clause is out of sympathy with gas trading of the times. In all the Orders, but one, in which illuminating power is dealt with, 14-candle gas is prescribed, tested by the No. 2 burner—the exception being in the case of Sheffield, an arrangement having been arrived at there for a standard of 15 candles with the No. 2 burner. The former standard was 16½ candles. Another noticeable point is that in the Burnham and the Highbridge Orders, clauses are inserted relieving the undertakers from any obligation to supply gas to users of suction-gas plant, if and so long as, in the opinion of the undertakers, the giving of such a supply would interfere with, or jeopardize, the supply to other consumers.

Royal Assent.

In the House of Lords yesterday week, the Standard Burner Bills received the Royal Assent—and they deserved it. We do not recall any other privately promoted measures affecting the gas industry that have continuously taken a full year to pass from notice to Royal Assent, or the full life of a Parliament to reach their final stage; nor do we remember a privately promoted Gas Bill that has received such rancorous opposition on the part of local authorities as these from the beginning almost to the end, and towards the end vexatious tactics causing postponement. Through it all, the measures have come with flying colours. The crowning point of Royal Assent was therefore (as already remarked) richly deserved.

Representation in Parliament.

The main topic of interest at the moment for the country is the General Election; but, irrespective of politics, in these columns our only interest is in the members who have association with the gas industry. With his intimate knowledge, as a professionally trained gas engineer and as Chairman of the Ipswich Gas Company and Deputy-Chairman of the Tottenham Gas Company, Sir D. Ford Goddard is, to the industry, a useful member in the House. He did excellent work in debate in connection with the opposition to the Standard Burner Bills last session. Notwithstanding that he has been ill, and unable to participate as he would liked to have done in the fight, he has again been returned for Ipswich, in the Liberal interest, at the head of the poll; his majority being 484—practically the same as at the beginning of the year. We heartily congratulate Mr. Reginald J. N. Neville on his conspicuous success for the Unionist party at Wigan. He is a Director of the Brentford Gas Company, and has taken a large part at the Parliamentary Bar and in the Law Courts in work connected with the gas industry. We may confidently look for his support, should occasion require, in the House itself. As a gas administrator, he ardently espouses the causes of cheap gas and a progressive policy; and (as may be seen from the proceedings at the meeting of the Gaslight and Coke Company in February, 1909) he has strong sympathy with gas employees. He has made previous plucky fights, though unsuccessful, to gain a seat for the Unionist party. This time he has wrested the seat at Wigan from the Labour party by a majority of 563 votes; last January, meeting the same Labour candidate, he lost by 510. Mr. H. Pike Pease has regained Darlington for the Unionists, which seat he lost last January to his Radical opponent by only 29 votes. This time he has been returned by a majority of 406 votes, which is better than the majority he secured at the 1906 election (288). Mr. Will Thorne, Socialist and Secretary of the Gas Workers' Union, has been re-elected by the huge majority of 4688, about 200 less than eleven months ago, and 550, or thereabouts, less than in 1906. Mr. W. H. Cowan, a Director of Messrs. Parkinson and W. & B. Cowan, who at the last election secured the representation of East Aberdeenshire in the Liberal interest with a majority of 2638, is again contesting that seat; and Mr. A. P. Main, of Messrs. R. & A. Main, Limited, is once more seeking the support of the voters in the Tradeston Division of Glasgow in the Unionist interest. His opponent at the last election had a majority of only 193.

The Output of Coal.

Even in the present time of political strife, it is not to be imagined that so important a Blue-Book as that which deals with the annual output of coal in the United Kingdom would altogether escape public attention. Statistics relating to this vast mineral wealth of the country are assured of a due amount of study, both for their own sake and for that of the many useful deductions that can be drawn from them. With the latter task, we will not now busy ourselves; but a few of the outstanding features of the statistics for the year 1909 (some figures from which were reproduced in last week's issue, while others are being given to-day) may be noted. The period referred to is, of course, long past, and we are now almost at the close of another year; but the compilation of figures for Government returns is, as everyone knows, always a matter of time. In 1901, the output of coal in the United Kingdom was 219 million tons; and there was a yearly increase until 1907, when the record figure of nearly 268 million tons was reached. The following twelve months, however, witnessed a reduction to 261¼ million tons. The present return shows that in 1909 the total output was upwards of 263¾ million tons which was an increase of some 2¼ million tons when compared with the preceding year. While, however, the output must thus be deemed to have been a satisfactory one, the colliery owners would probably have been far better pleased if the value at the pit had advanced in a corresponding degree. But this it did not do. On the contrary, the value of the 263¾ million tons is stated to have been £106,274,900, which, in spite of 2¼ million tons greater output, was a decrease of no less than £10,323,948 on the value of the output the preceding year. The drop in price was a considerable one; the average value at the pit's mouth being 8s. 0·7d. per ton in 1909, as compared with 8s. 11d. in 1908. In connection with this matter, it may perhaps be pointed out that, though the price of 8s. 0·7d. per ton in 1909 showed a substantial falling off when placed side by side with the 8s. 11d. of 1908, the average price at the pit as recently as 1906 was a good deal lower still, at 7s. 3½d. per ton. What became of all this coal that was raised last year? The quantity exported, exclusive of coke and manufactured fuel, and of coal shipped for the use of steamers engaged in foreign trade, was over 63 million tons, which was an increase of more than half-a-million tons on the exports the year before. Adding the 3¼ million tons exported in the form of coke and manufactured fuel, and the 19¾ million tons shipped for the use of British and foreign steamers engaged in foreign trade, the total quantity of coal which left the country was 86 million tons. Thus the amount of coal remaining for home consumption was 177¾ million tons, which represented 3·949 tons per head of the population—an amount which has been exceeded, and then only by a little, on but six occasions during the thirty-seven years over which the statistics extend. The lower price of coal last year did not, of course, apply merely to that consumed in this country; for we received about £4,500,000 less in respect of the exports than was the case in 1908, in spite of the fact that, as already stated, some half-a-million tons more coal was sent out of the country. It is set forth in the Blue-Book that during the past thirty-seven years (1873 to 1909) the value of the coal raised amounted to £2,467,976,000, or 82¾ per cent. of the total value of the minerals raised over this period in the United Kingdom. Of the output of 6,856,407,000 tons of coal which is represented by this sum, nearly 23 per cent. has been shipped abroad as exports in the form of coal, coke, and manufactured fuel, and as fuel used for steamers engaged in foreign trade.

Some Rating Statistics.

Our "Miscellaneous News" columns to-day bear testimony to the fact that we have received from Mr. James Carter, Borough Treasurer of Preston, a copy of his return for 1910-11 of the rates levied in certain towns, and various matters in connection therewith. This statistical compilation is one which we have often before noticed in our pages. In fact, it is stated that the present is the twenty-sixth annual statement of the kind that has been issued. But it has not always been of the same extent as at present. From time to time additions to the number of places included have been made, until now ninety-four towns and Metropolitan boroughs are dealt with—this, by the way, being the same number as last year. Both large and small places are included, with the idea of making the return as representative as possible; and the information furnished, in addition to the amount of the rates, includes the charges for gas, water, and electricity, and the profits and losses on municipal undertakings by which the rates in the particular towns referred to have been reduced or increased. And not merely in size, but in character also the towns selected vary. Some are known as trading and manufacturing centres, while others are seaside resorts and general residential districts. Looking down the list, it appears that the cases in which the rates levied for 1910-11 are less than those raised the previous year are very nearly equal in number to those in which the amount is higher. Dealing with the latest return, there are twelve places where the amount in the pound levied for rates is shown to be 9s. or over. This number compares with thirteen a year ago, and seven for the year before that. Norwich heads the list with 10s. 3d. in the pound; but as is generally the case the two "Hams" are well in the running—East Ham with 9s. 10d. and West Ham with 9s. 9d. This is an increase of 4d. for the year in the case of Norwich, and of 7d. in that of West Ham. There is, however, a falling off of 1d. in the amount levied in East Ham. The number of instances in which the rates amount to 8s. or more in the pound is 33 on the present occasion, as against 36 and 24 for the two immediately preceding years. The only places included in the list in which the rates are 5s. or less in the pound are Bournemouth (5s.) and Oxford (4s. 3d.). The latter place benefited to the extent of 7¾d. in the pound from "reproductive" undertakings; but Bournemouth experienced losses which increased the rates by 1d. In 17 of the places dealt with by Mr. Carter the price of gas is 2s. or under per 1000 cubic feet for domestic lighting purposes, as compared with 16 last year—the new comer being Oldham. Widnes occupies, as usual, the first place in regard to cheapness. For a domestic lighting supply of electricity, two places in the list charge 6d. or more per B.T.U.; while in Lincoln the average charge is 2½d., in Ashton-under-Lyne it is 3d., in Wolverhampton the average is also 3d., and in West Ham there is a flat-rate of 3d.

Ten of the towns (as against twelve last year) relieve the rates to the extent of 1s. or more in the pound in consequence of the "rents of property and profits transferred from gas, water, markets, &c.;" but there is also a list—which includes 42 out of the 94 towns—of places in which deficiencies on municipal undertakings led to the rates being increased—in four cases by upwards of 1s. in the pound.

The Globe and the Light.

In technical circles into which the question of illumination wholly or partly intrudes, the subject of dioptrics is constantly being lifted to the surface; and it is never dropped again without something good being said as to Holophane globes, and deservedly, as if a globe ever had scientific consideration applied to its design above all others, this is the one. The principles are sound; the effects precisely those desired. But commercially the Holophane globe was before its time. There was not the extensive use for it in its early years that there is to-day. The metallic filament lamp has meant its commercial salvation on account of what Mr. W. M. Mordey, erstwhile the President of the Institution of Electrical Engineers, has described as the "whip-lash" on the eyes of that particular form of electric lamp. It is recognized by electrical engineers, physiologists, oculists, opticians, and others concerned that the glare of the concentrated intensity of metallic filaments is very harmful to the human eye; and the Holophane globe is just the thing to break down the glare, and render the light comfortable. Much has of late been written on the subject. Among others, the engineering contributor of the "Daily Telegraph" has had a turn at it. His view is that "the globes are simply indispensable for metallic filament lamps," for the purpose of diffusing light, so that the eye should never be dazzled even when looking towards the lamp. But, of course, these globes mean much extra expense, though, on the other hand, they do not absorb the light in the manner and to the extent of other globes. They are, however, less expensive than lighting by means of reflected light from lamps hidden along the cornice, as in the case of the lecture hall of the Institution of Electrical Engineers; this system having been, it will be remembered, adopted there solely in order that the eyes of members might not at their meetings be offended by the lamps, of the glare of which they say nothing to the public.

Liability for Damage to Street-Lamps.

Early this year, the Works Committee of the Stepney Borough Council called the attention of the Council to a communication received from the Town Clerk of Kensington to the effect that the Council of that borough were unable to recover a large proportion of the money expended on repairing damaged street-lamps, owing to the fact that they could not look to the owner of any vehicle causing the damage for the cost of repairing it, but only to the driver—he being the person responsible within the meaning of section 207 of the Metropolis Management Act, 1855. The Stepney Council resolved to support a request addressed by the Kensington Council to the London County Council that this authority would insert a clause in one of their General Powers Bills having for its object the amendment of the Act. The matter having been brought under the notice of the County Council, a resolution was passed by them sanctioning the promotion of legislation in the direction indicated; and it has been carried into effect in the Various Powers Bill of which the Council have given notice, some features of which were indicated in the "JOURNAL" last week. The Council ask for the amendment of the Act named so as to provide that, in any case in which a vehicle causes damage to the property of the Council or any local authority in any street, the owner of such vehicle or the employer of the driver thereof shall be liable for any damage caused by it, "in addition to, or in place of, the driver."

The Latest Gas Undertakings Returns.—The returns relating to the authorized gas undertakings in the United Kingdom for the year ended Dec. 31, 1909, in the case of the Companies, and March 31 last for the Local Authorities, were issued yesterday. The principal totals will be found in another part of the "JOURNAL;" and other statistics will be given next week, when opportunity will be taken for dealing with them in their entirety. Meanwhile, it may be mentioned that in the period named no less than £132,123,284 was employed, out of £154,500,093 authorized, in the supply of gas, of which nearly 177,687 million cubic feet were old to 6,164,066 consumers and for use in 712,903 public lamps.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 739.)

THE Stock Exchange had a bright and cheerful time last week on the whole, with perhaps the single exception of the American Market, which moved in response to special influences. The beneficent factors were the cheapening of money and sanguine expectations from the Unionist point of view regarding the elections. Business was not as brisk as it might have been; the settlement of the long account engaging much attention. The reopening on Monday partook of the cheerfulness which had marked the close of the previous week. Government stocks were quite firm, Rails active and rising, the Foreign Market showed strength, but Americans were weak. Tuesday was inactive; and some realization set prices back from their recent rise. But Government issues were firm, and Consols rose ¼. On Wednesday, fresh business was scarce; but the general tendency was excellent. Consols gained ⅜, and several other of the choicest class advanced. Rails improved; and Foreigners were stronger. On Thursday, more activity and continued cheerfulness were apparent. Consols rose, and not even the weather could depress Rails. Friday relapsed into quietude; but the good tone was maintained spite of Friday realizations. Consols rose ¼, and the leading departments were stronger generally. On Saturday, the general buoyancy was slightly checked by a tendency to reaction after the liberal advances of the week; but movements were not considerable. The Money Market was easy; and on Thursday the Bank of England rate was reduced to 4½ per cent. from the 5 per cent. rate which had lasted six weeks. Business in the Gas Market was a good deal quieter, owing, in some measure probably, to a shortness of stock. Changes in quotation therefore were exceedingly few in number; but they were all in the upward direction. In Gaslight and Coke issues, the ordinary was less dealt in than of late, but was very firm. One transaction was marked at 105⅜, but the final price was 106¼—a rise of ¾. The secured issues were fairly active. The maximum changed hands at from 87 to 88½, the preference at from 103¾ to 104½, and the debenture at 80¾ and 81½. South Metropolitan was little touched; and the old figures of 121½ and 122½ were unchanged. The debenture was dealt in at 81⅜ and 81½. Nothing at all was done in Commercials. Among the Suburban and Provincial group, Alliance and Dublin marked 97, British 44¼ free and 44⅝, Bournemouth "B" 16½, Brighton and Hove ordinary 159 to 160½, Brentford new 189, and South Suburban 120½. In the Continental companies, Imperial was stronger, and was done at from 185 special to 186½ (a rise of 1), ditto debenture realized 95, European fully-paid 23¾ and 24, ditto part-paid 17⅞. Among the undertakings of the remoter world, Cape Town preference changed hands at 4 15/16, Primitiva at from 7¼ to 7 7/16, and ditto preference at from 5 3/16 to 5 5/16.

ELECTRICITY SUPPLY MEMORANDA.

The Marylebone Réchauffé—That Comforting Term "Load-Factor"—Gas-Lamps Electrically Tested—Reconnoitring (?)—Conditions of Holborn Trials—Belief and Gibes—Want of Commercial Qualification—Hastings Workhouse Lighting.

BEFORE the members of the Institution of Electrical Engineers, Mr. Haydn Harrison has been dilating upon the subject of "Street Lighting by Modern Electric Lamps;" and as is the way of most electricians, he has, in the most prominent part of his paper, made comparison with—not the modern, but early forms of incandescent gas-burner. Never on any occasion, within our recollection, has Mr. Harrison been guilty of transgressing the electrical rule never to say a good word for gas lighting; and, so far as we can trace, his tests of gas-lamps singularly enough never, or rarely, give the same results as those of equally reliable gas photometrists who we believe to be as honest as Mr. Harrison would himself claim to be. In this case, the paper was constructed in the same old partisan style. He told once more the story of street lighting in Marylebone with the "modern" metallic filament, and with anti-modern forms of incandescent gas-burner. There was nothing new in it; and it was because of that, that the story suited Mr. Harrison, and pleased his hearers. It is not very enchanting to electricians to hear what might have been in Marylebone if the lighting had been up for fair competition to-day; and it is not pleasant to them to remember that the inverted mantle has succeeded this year in retaining the street lighting in so many boroughs of London for a further contract period, notwithstanding the example of Marylebone, and has effected a brilliant show in the streets of Westminster. If Mr. Harrison—or rather some impartial illuminating engineer—had attempted to compare the "modern" metallic filament in Marylebone with the modern inverted gas-burner, he might have shown that Marylebone is not under the present change representative of the most economical and efficient means of street lighting. We may recommend to his notice a little exercise of our own in this connection, as published in the "JOURNAL" for Sept. 13 last (p. 706).

But croaks the "Electrician," as it has croaked so often before, "there is good reason to think that prices given by the gas companies two years ago were on more commercial lines that those recently adopted in Westminster." If our contemporary studies

the prices quoted for low-pressure inverteds (and they now represent the bulk of the lighting in boroughs where the new contracts have been lately settled), it will find that the quotations in the several different districts for equal candle-power lamps run on similar lines; and does it really think it possible that a large trading concern like the Gaslight and Coke Company would take up the lighting of thousands upon thousands of street lamps in the manner done this year with a loss upon each? The extent of the business transactions entered into in this direction is a sufficient answer to the absurdity. The writer of the sentence quoted at the opening of this paragraph ought, possessing such sparkling business perception, to have no difficulty in securing a position with the Gaslight and Coke Company for the special purpose of keeping the commercial part of their business from deviating from correct lines and principles. Of course, it will have been noticed by our contemporary how gas prices are dropping in London through the greater manufacturing economies that have been discovered in change of methods; and it will be within its knowledge that the inverted gas-burner is more economical in consumption and upkeep than the vertical form of burner. But our contemporary goes on: "It cannot be said that the electric energy for street lighting is supplied at an unremunerative figure." How could anyone say such a thing! "The price charged is quite satisfactory," it proceeds to remark, "having regard to the load factor of the public lighting." To electricians there is as much comfort in the term "load-factor" as the old lady found hearing the "blessed word Mesopotamia." But while the electricians find the much-abused "load-factor" a refuge and help in the time of trouble, they cruelly deny the right of the gas industry to have any load-factor, or to even harbour any thought of such a thing. What is regarded as commercial in the matter of price for electricity supply is uncommercial in gas supply. "Heads I win, tails you lose," and "What is sauce for the goose is not sauce for the gander" are apt classical apothegms.

One point more on this occasion in reference to Mr. Harrison's paper on "modern" electric lamps, in which paper he, as already remarked, mixes up a good deal about gas-lamps, some of which are not "modern." He quotes again those much-cited figures of Professor J. T. Morris published two-and-a-half years ago regarding the variations he found, under conditions that are not clearly defined, in the illuminating power of the Keith inverted gas-lamp, which variations he attributed to differences in quality and pressure of gas. Mr. Harrison states that his own tests corroborate Professor Morris's findings; and he asserts that he has found a nominal 1500-candle power Keith lamp which showed between 720 and 780 candle power. Strange that this test should be absolutely uniform with one that was published by Professor Morris! Perhaps Mr. Harrison will tell us where this lamp was tested, when, and the pressure of the gas. The information will be in his possession as he knows that the consumption of this particular lamp was 23 cubic feet per hour; and we should like to be informed where a test can now be made of the same lamp. It will be remembered that—this was some two-and-a-half years ago—Professor Morris did not say there was any difficulty in getting the full nominal illuminating power of the lamps, under fairly constant conditions; and it would hardly be Mr. Harrison who would make the acknowledgment. As a matter of fact, ordinary pressure and calorific conditions in London have undergone considerable change with the incoming of the inverted lamp, the big extension in the use of gas heating, and penal testing for calorific power in the 100 square miles of the Gaslight Company's area. Used under their intended conditions, it must be that there are no gas-lamps that are subject to more uniform pressures than these high-pressure inverted gas-lamps. Whatever pressure they require can be delivered to them at will through the high-pressure mains; and the official calorific power tests at the London County Council testing-places dotted all over London vouch for an approximate uniformity in this regard—differences in the returns being insufficient to cause any material change in the illuminating power of a high-pressure lamp, worked at such pressures as are these Keith inverteds under ordinary circumstances.

If any value attached to Mr. Harrison's assertions as to only being able to secure 50 per cent. of the nominal illuminating power of these lamps in his tests, then the penal conditions attaching to the Westminster contract would place the Gaslight and Coke Company in a very serious position. But let any electrician who can or who will recognize truth when it is met with walk in Pall Mall and Regent Street, or in Fleet Street any evening, and say whether the lamps there are returning a duty 50 per cent. below their nominal designation. These lamps throw back the electrical absurdities in the teeth of those who make them. Against Mr. Harrison may be quoted the independent test made by Mr. J. F. Simmance of the illuminating power of one of the Aldwych trial lamps last August (see "JOURNAL," Aug. 9, p. 400), when he found the illuminating power of the lamp at 50° angle 3712 candles and at 20° 4288 candles, under pressure conditions there prevailing, for a three-burner gas-lamp. Mr. Simmance quotes the conditions of the test that were within his knowledge as a photometrist. The comparatively small difference between the candle-powers at the two angles is very striking; but the higher figure is at 20° from the horizontal. Mr. Harrison seems to have a preference for quoting for metallic filament lamps the candle power at angles of 10° and 20° from the horizontal, and the measurements give nearly double the value to the 10° rays as to the 20° ones. This is a large difference between two such close angles. On one occasion before, we remember Mr. Harrison talking of making a selection in his tests of the important rays. The idea is good. But for the 50° and 20° angles, Mr. Harrison will no doubt be delighted with the results found by Mr. Simmance, whose competence and knowledge as a photometrist is universally acknowledged, as was also his honesty until the latter-day illuminating saints descended into our midst, and began to study in their own pretty ways matters photometrical. But is it not time that Mr. Harrison and other electricians appreciated that that little ruse of theirs, of quoting Marylebone lighting past and present—old gas conditions with new electrical ones—is getting well understood by local authorities unattached to electricity undertakings, who are interested in learning what are the concrete facts regarding the new inverted gas-burners which are doing so well in London boroughs?

Touching that Gower Street trial lighting which is to offer the Holborn Borough Council some guidance in the matter of their street-lighting contract, the electricians will not be able to complain of any want of knowledge in their effort to win the prize. Sundry single and duplex inverted gas-burnered lamps had made their appearance in Gower Street early last week; and a band of young gentlemen were found making tests at various angles with the instrument placed a certain distance from the ground, and at different taped distances from the lamp-posts. The diligent operators were not recognized. Therefore the question naturally crosses the mind, were they from the Borough Council Office, or were they from the electrical camp reconnoitring to ascertain the candle-power of the lamps of their competitors? The electricians cannot complain that want of information killed their chances of success. They have before them the tender of the Gaslight and Coke Company.

The specification of the conditions on which the Gower Street trials are to be carried out has been issued by the Borough Surveyor of Holborn; and there does not seem to be a single point in them that commends itself to the electrical (would-be) dictators as represented by "Meteor" of the "Electrical Times." Nothing is right; and nothing would please but conditions defined entirely by electrical fancy to meet the special needs of the metallic filament lamp. Incidentally, "Meteor" makes out that the metallic filament lamp is a most awkward thing to which to apply reflectors to get light into the photometer at the Westminster angles—in short, the whole specification is thoroughly bad, vague, and arbitrary in the judgment (the qualified and expert judgment) of "Meteor." This is all the fearful, ire-raising specification amounts to: Each lamp is to give a maximum candle power of 300 candles, when measured by a Trotter photometer at the ground level. The reflectors are to be flat or slightly convex, and are to be placed horizontal. The candle power will be arrived at by taking the average of two sets of readings in any position with regard to the light under test—one set at an angle of 20°, and a second set at an angle of 50° to the horizontal. The tests are to be taken so that they are not interfered with by glazing-bars, and in reasonably clear weather—*i.e.*, not during rain, mist, or fog. Not less than three, and not more than six readings, at regular intervals of not less than 30 or more than 60 seconds, are to be made at each angle; and the average will be termed the illuminating power at that angle.

One of the little fads of the "Electrical Review" is to attack all who venture to talk of short-circuits and fusion of electric wires when there is an outbreak of fire. If there has ever been a single occasion on which that paper has not reared at the one or the other of the statements, then that is the only occasion on which it is believed by the estimable joint editors that electricity has really been the culprit. It has had a little poke at a provincial paper which, in reporting the destruction by fire the other week of the Wellingborough Music Hall, says: "Though it cannot actually be stated as a fact, it is believed the outbreak was due to the fusion of an electric wire." Following the protest regarding Wellingborough, there is another paragraph, which opens in this effeminate style: "We do not question for a moment that all gas explosions are 'alarming,' for really they do give you a shock, you know." Then the paragraph proceeds: "A Glasgow paper, however, says that one of these 'alarming' events that occurred in that city last Friday [this would now be a little more than a fortnight since] is believed to have been caused through a defective electric light fitting . . . melting a gas-supply pipe. The Daily Press has a remarkable ability for believing some things." Now Mr. W. W. Lackie, the Corporation Electrical Engineer of Glasgow—unlike the "Electrical Review"—has never shown any disposition to minimize danger where he believes danger exists; and he does regard this question of the fusing of gas-pipes by electric wires as a serious matter. We remember his report that, between 1902 and 1908, 61 fires in Glasgow were due to defective electric wires, several of which set up fusion of gas-pipes. There is the case of a public man at Belfast who not long since was suffocated by gas through the pipe-penetrating capacity of a leaky electric light wire. There was the case recorded in our "Correspondence" columns recently in which an explosion of gas was caused by a leaky electric meter being placed in proximity to a gas-meter. It is quite possible that the Glasgow reporter had more ground for his belief than the "Electrical Review" had for its gibe.

It has been matter for remark on previous occasions that our electrical contemporaries appear to be very dissatisfied, generally speaking, with the type, or rather the accomplishments, of men at the head of the electricity supply undertakings of the country. If repetition of the point cannot bring about a change, then the

fault will not be that of the electrical press. Commenting upon an address delivered by Mr. M. J. Railing, to the Birmingham Local Section of the Institution of Electrical Engineers, the "Electrician" says that "he is strongly convinced that one very important factor contributing to our set-back is that we still try to use both commercial and theoretical men as of old, whilst other countries have developed a type of man who combines the qualities of an engineer and of a commercial man in one. . . . The tendency of electrical engineers in this country to confine themselves to technical questions is, we think, continually being emphasized; one of the most striking instances being in connection with electricity supply. The engineering results of our undertakings compare most favourably with those achieved abroad; but in the method of developing the supply and obtaining consumers, we have something yet to learn." It must be very distasteful to electrical engineers to be constantly pilloried over their commercial disqualifications in the manner to which our electrical contemporaries are addicted. As we have said before, a little practical experience of the commercial difficulties of electrical engineers would make their accusers, if not sadder (that might not be possible), certainly wiser men.

In dealing with the question of the lighting of the Hastings Workhouse last week, there was an error in the figures, which rather spoilt the argument. The corrected figures are in the following passages: "Excluding capital expenditure, the annual charge for electricity is put at £190. Now the Gas Company have shown the rash haste of the Guardians in the matter by offering, if they are still enamoured of electric lighting and really wish to oust gas lighting, that they are prepared, for £160 per annum (subject to necessary agreement), to convert sufficient gas for the supply of the current necessary for the 486 lamps as per the Borough Electrical Engineer's list (see p. 555), though there is no wish, on the part of the Gas Company's technical advisers, to endorse the economical views of this gentleman as to the quantity of light required."

PERSONAL.

Mr. L. J. HOYLES, of Stratford-on-Avon, has been appointed Second Engineer of the Rosario Gas Company, Argentina, South America. Mr. Hoyles was for three years a pupil under Mr. W. G. S. Cranmer, the Manager to the Willenhall Gas Company; and for the last four-and-a-half years he has been Draughtsman and Assistant to Mr. Henry Fowler, the Gas and Chief Mechanical Engineer to the Midland Railway Company, Derby. Mr. Hoyles is a member of the Midland Junior Gas Engineering Association.

Mr. MAURICE GRAHAM has just been elected a Fellow of the Royal Geographical Society. He is about to leave England for an extended visit to the Continent; and soon after his return to London (about March next), he intends starting for a tour through South Africa and South America, visiting the principal cities and towns in both countries. On the completion of this second visit, Mr. Graham probably will have had more experience of the conditions of gas supply in parts far away from England than any other present-day engineer; and the knowledge he will gain in this way, coupled with his earlier career as a gas-works contractor, will stand him in good stead when eventually he settles down as a consulting engineer.

OBITUARY.

By the death last Thursday, at the age of 69, of the Right Hon. J. E. ELLIS, the Scarborough Gas Company have lost a Director, and the House of Commons one of its most respected members. Mr. Ellis had been suffering from asthma, and, owing to the state of his health, was compelled to decline nomination for the Rushcliffe Division of Nottinghamshire (which he had represented for a quarter-of-a-century) for the present election.

Much regret has been expressed in Lancaster at the death at "The Ridleys," Wennington, of Mr. JOHN CHAPMAN MOUNT, who only retired from the position of Water Engineer and Borough Surveyor to the Lancaster Corporation two months ago, as was notified in the "JOURNAL" at the time. Deceased served his articles with Mr. Cook, now the Water Engineer to the Fylde Water Board, and succeeded him when he left Lancaster in 1902. The Blea Tarn reservoir was constructed during his time. The deceased was 43 years of age; and he leaves a widow.

The death occurred recently, in his 83rd year, at his home in Brooklyn, of Dr. HENRY WURTZ, a distinguished American chemist, who was at one time Editor of the "American Gaslight Journal." Pending the publication of a fuller notice of the deceased, our contemporary says of him he was "one of the old-school chemists, a man of erudition and high scholastic attainments, a contemporary and friend of Professors Hunt, Silliman, Dana, Hitchcock, and that brilliant set who in the early seventies electrified the chemical world with their seemingly iconoclastic outputs." He was Editor of the above-named paper in the interim between the death of Mr. Mills L. Callender and the accession of Major Dresser (1871 to 1875). At the beginning of the Civil War, Dr. Wurtz was Chemical Examiner in the United States Patent Office, as well as Professor of Chemistry in the National Medical College at Washington. He was the author of numerous scientific treatises,

THE LAST GAS EXAMINATIONS.

Report of the City and Guilds of London Institute.

WE have received from the Superintendent of the Department of Technology of the City and Guilds of London Institute (Sir Philip Magnus) the report on the work of the department during the past session. We extract from it a few particulars as to the examinations in "Gas Engineering" and "Gas Supply."

First of all, as showing the extent of the work of the department, it may be mentioned that at the recent general examination in technology 24,508 candidates were presented from 418 centres in the United Kingdom; and 14,105 of them passed. By including the candidates from India and the Colonies, and those for the teachers' certificates in manual training and domestic economy, the total number of examinees was 26,878. These figures show an increase on those of any previous year. In order to secure the expert advice of trade societies and professional bodies in the conduct of the department's educational work, the Institute have arranged for the formation of several Advisory Committees, consisting of persons interested in different trades and industries, and possessing a full knowledge of their technical details. The functions of each Committee are to suggest improvement in the Institute's syllabus of instruction, to recommend new examiners for appointment, and generally to advise on any matter connected with the course of instruction or the examinations which may be referred to them. The Council of the Institution of Gas Engineers have consented to act as an Advisory Committee in the subjects of "Gas Engineering" and "Gas Supply." By the aid of these Committees, the Institute are enabled to promote useful relations between trade organizations and the schools in which artisans and others receive their technical instruction.

Coming to the general work of the department, we find that the number of subjects in which examinations were held last session was 75, compared with 73 before; and the number of separate classes was 4329, against 4021—the former figure being the highest on record. The number of students in attendance was 53,227, compared with 48,897. In the subjects of "Gas Engineering" and "Gas Supply," the number of students increased from 652 to 757; but that of the candidates decreased from 626 to 614. The programme for the session 1910-11 was issued in June, and was noticed in the "JOURNAL" at the time.

Turning to the tables which give the results in the separate subjects, the report shows that in the two relating to gas there were 26 centres, with (as already mentioned) 757 students in attendance, compared with 22 and 652 before. The candidates numbered 304 in "Gas Engineering," and 310 in "Gas Supply," compared with 311 and 315 before. In the Honours grade, in the former subject, 43 passed in the first class, 39 in the second class, and 24 failed; while in the Ordinary grade the passes were 67 and 53 respectively, and the failures 78. There were consequently 202 passes and 102 failures, or 33·5 per cent. In the Honours grade in "Gas Supply," 23 candidates passed in the first class, 37 in the second, and 33 failed; while in the Ordinary grade 54 passed in the first class, 81 in the second, and 82 failed. There were thus 195 passes and 115 failures, or 37 per cent.

Of the total number of students in the two subjects, 3 of the 13 who attended classes at the Battersea Polytechnic passed in the Ordinary grade in "Gas Supply." At the Goldsmiths' College, out of 34 students in attendance, 13 were examined and 7 passed in the same subject—6 in the Ordinary and 1 in the Honours grade. From the classes at the Regent Street Polytechnic 40 students out of 54 were examined in "Gas Engineering" and 7 in "Gas Supply." Of the former, 20 passed in the Ordinary and 10 in the Honours grade. Of the 7 candidates examined in "Gas Supply," 2 passed in the Ordinary and 4 in the Honours grade. There were 6 candidates from the Woolwich Polytechnic examined in "Gas Engineering," and 3 passed in the Ordinary grade. From the various schools of the London County Council, out of 125 students in attendance at classes for "Gas Supply," only 20 were examined, and of these 6 passed in the Ordinary and 5 in the Honours grade—one being a prize winner. One candidate was examined at Lithgow (New South Wales) in "Gas Engineering" and another in "Gas Supply;" and they both passed in the Ordinary grade.

Reporting upon the work of the students in "Gas Engineering," the Examiner (Mr. Thomas Glover) says:

A general review of the results gives the impression that the knowledge of many candidates is too general. There is revealed an insufficient knowledge of detail; and in many cases the inability to make good sketches and proportionate drawings prevents candidates from expressing their knowledge in an acceptable manner. This was most evident, strange to say, in the Honours examination. Students would be well advised to take their "Machine Drawing" and "Mechanical Engineering" courses before sitting for the Honours "Gas Engineering" examination, and to accustom themselves to draw and sketch every important piece of apparatus in use on the works where they are employed.

There is distinct evidence that many of the candidates have been well taught; and the acquaintance with modern methods of chemical testing is quite gratifying. The formation of cyanide during the process of carbonization, and its subsequent washing-out from the gas, appears to be imperfectly understood; and the same may be said about the use of heavy charges of small coal and the modern practice of longer periods for carbonization.

It is of importance that candidates should answer the questions set

at the examination in as direct a manner as possible. Several candidates of evident ability obtained comparatively few marks by writing essays on one or two questions. Students employed on small works should take every opportunity of visiting larger works, and enlarge their outlook by diligently reading the Technical Press; and they would also gain in many ways by associating themselves with other students.

Mr. J. H. Brearley, the Examiner in "Gas Supply," reports as follows:

It is again necessary to refer to the great difference in the quality of the papers submitted. There are a large number of papers which show either very inefficient preparation or poor tuition. The scope of the syllabus is so wide that only candidates who work assiduously throughout the winter months can reasonably hope to pass in the first class. There is a gratifying reduction, however, in the number of students who have obtained less than 30 per cent. of the total possible marks. The number of candidates, too, who have attempted six questions or less in the Ordinary grade is smaller this year. The Honours students have shown a greater appreciation of the use of squared paper for plotting illumination curves. Many candidates waste time in writing matter which is not pertinent to the subject of the questions; and there were two or three instances where candidates did not follow the instructions as to answering only one of alternative questions.

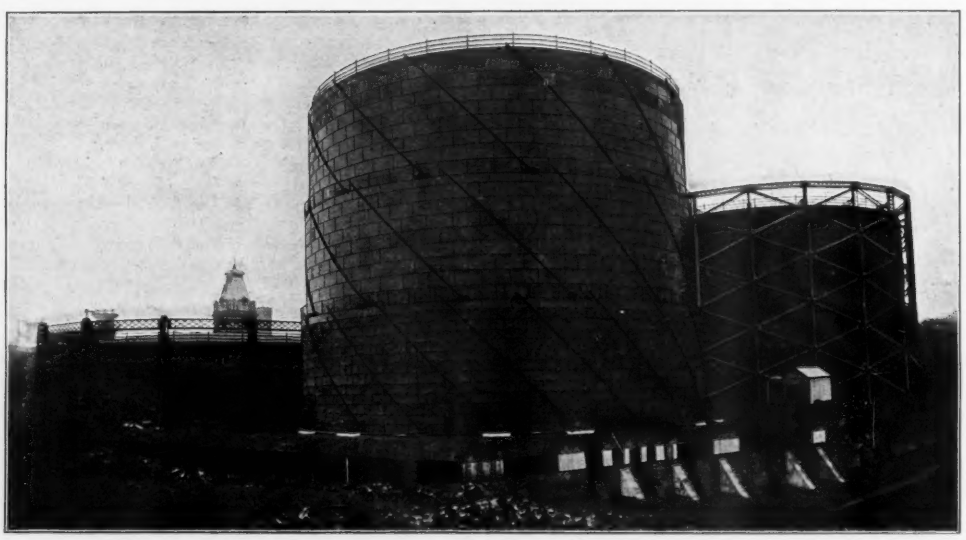
The questions in "Gas Supply," with the answers, were given in the last volume of the "JOURNAL" (pp. 29, 108, 186, 259). The names of the successful candidates in both subjects will be found in Vol. CX., pp. 776, 934, and Vol. CXI., pp. 21, 106, 174; and those of the prize winners in the issue for Aug. 2 (p. 317).

GASHOLDER EXTENSION AT TUNBRIDGE WELLS.

THE increasing demand for gas in the district supplied by the Tunbridge Wells Gas Company has recently made it imperative that the Company should extend the capacity of their gas storage plant. Some of our readers will remember that the works were erected about the year 1878, according to the designs of the late Mr. R. P. Spice, who was at that time the Company's Engineer. They included two single-lift gasholders, 112 feet in diameter by 30 ft. 6 in. high. The holders, as well as most of the apparatus on the works, were constructed by Messrs. S. Cutler and Sons, of Millwall; and, after consultation with this firm, the present Engineer (Mr. Andrew Dougall, M.Inst.C.E.) recommended his Directors to provide the additional storage required by transforming one of these single-lift holders into a three-lift telescopic holder of the following dimensions: Outer lift, 112 ft. by 30 ft. 6 in.; middle lift, 109 ft. 2 in. by 29 ft. 6 in.; inner lift, 106 ft. 5 in. by 30 ft. 2 in. The landing stones, not being long enough to take the three lifts, the middle lift is supported upon brackets attached to the outer lift, and the inner lift on brackets fixed to the middle lift.

On examination, it was found that the original holder could be utilized in the enlargement, as it was in excellent condition; and it was, therefore, determined to use the sides for the outer lift and the crown for the new inner lift. The existing guide-framing constructed for a single-lift holder was not at all suitable for extension; and it was decided to discard this framing altogether and adopt the spiral-guided system.

The work thus designed has been carried out in a most efficient manner by Messrs. Cutler and Sons; and in respect to many of its details, they have introduced special features peculiar to their manner of constructing spiral-guided gasholders. These include their patent arrangement for providing a flush and uninterrupted surface for the spiral rails to bear against. This device avoids the necessity for using narrow strips, with the accompanying necessary continuous lines of rivets, and making use of sheets of the ordinary dimensions corresponding to those in other parts of the holder—in this manner answering most satisfactorily. The guiding wheels also are fitted with Cutler's improved devices for adjustment. The successful working of this guiding apparatus was demonstrated when the holder was first inflated by air, which happened to be at the time of one of the strongest gales of the past season.



The New Spiral-Guided Gasholder at Tunbridge Wells.

The work has been carried out under conditions of exceptional difficulty, inasmuch as the water could not be removed from the tank. The erection of the two new lifts, therefore, together with the alteration of the existing work (including the requisite reduction in the diameter of the crown and the crown-framing), has all been carried out over the water; and this has been successfully accomplished without accident or mischance of any kind whatever—no doubt, largely due to the adequate and complete plant provided by the Contractors, and the skill, resourcefulness, and unremitting attention bestowed upon the work throughout.

On the invitation of the Directors of the Tunbridge Wells Gas Company, a number of representative residents visited the gas-works last Tuesday afternoon to witness the inauguration of the new holder referred to above, and also to inspect the Company's works. The visitors, on their arrival proceeded at once to the new holder, where the Chairman, Mr. W. H. Delves, J.P., amid applause, opened the outlet valve, thus allowing gas to pass out of the holder to the town for the first time. Afterwards three parties were formed for a general inspection of the works—Mr. Andrew Dougall, the Engineer and General Manager, and other officials acting as guides. Starting at the coal-stores, which have a capacity of 3500 tons, they proceeded to the retort-house, where the process of carbonization was fully explained. The plant consists of 240 retorts, capable of dealing with 150 tons of coal per 24 hours. The tar-extractor, naphthalene washer, condensers, scrubbers, and purifiers were then inspected in turn. The engine and exhauster room claimed a good deal of attention—especially the 50 H.P. engine and accumulator, which provide the hydraulic power for working the lifts, cranes, capstan for hauling trucks in and out of the railway siding, &c. The carburetted water-gas plant, which is in two sections, and will produce a million cubic feet of gas per 24 hours, aroused great interest. The sulphate of ammonia apparatus was also inspected. This plant turns out about 200 tons of sulphate of ammonia per annum, fully one-half of which is sold to local farmers. The parties then made their way to the laboratory, where the various chemical and physical tests were explained, for ascertaining the illuminating and calorific values of the gas, its purity, and the commercial value of the bye-products.

At the conclusion of the inspection, the party assembled in the Manager's office, and partook of light refreshments.

The CHAIRMAN, in a few remarks, after welcoming the party, traced the progress of the undertaking, which had, he said, now been brought by the developments of science to such a high state of efficiency. When the works were built in 1878, storage was provided for 580,000 cubic feet of gas; in the year 1889, this was increased to 1,220,000 cubic feet by the erection of a two-lift gasholder; and now the total storage had been brought up to 1,718,000 cubic feet by the construction of the new three-lift holder, which was capable of containing 788,000 feet, and, when fully inflated, reached a height of 85 feet. The Directors were perfectly satisfied with the way in which the Contractors (Messrs. Samuel Cutler and Sons, of Millwall) had performed their work, and complimented them upon the fact that it had all been carried out without any accident. Mr. Delves gave other particulars concerning

the Company—incidentally mentioning that, whereas the price of gas to the consumer was formerly 4s. 2d. per 1000 cubic feet, it was now 2s. 7d. He also said that the Company used 20,000 tons of coal per annum, and paid £12,000 in wages; alluding, in conclusion, to the co-partnership scheme which had been successfully introduced in connection with the employees, so as to encourage thrift.

Mr. SAMUEL CUTLER remarked that it was about forty years ago that the Company first became their customers; and he would like to say that his firm had always received the greatest kindness and courtesy at their hands. The fact that they had now entrusted the present work to them was a great compliment—implying, as it did, that their previous work had been carried out satisfactorily. He thanked Mr. Delves for the appreciation that he had expressed, and he trusted that his firm would build them another similar holder at some future time. He would also like to express his warm obligations to Mr. Dougall for the assistance he had given them in carrying out the work. The conditions under which it had been done were abnormal; but the difficulties had been successfully surmounted, largely owing to his arrangements. Thanks were also due to the workmen for so carefully executing the work. As a souvenir of the occasion, he asked Mr. Delves's acceptance of an album which would contain photographs, &c., of the old and new arrangements.

Mr. DELVES having briefly acknowledged the gift,

Mr. W. C. CRIPPS, on behalf of the visitors, returned thanks for the invitation, and for the opportunity of inspecting this most valuable and interesting undertaking, which, by the way, was almost a child of the Chairman. He remembered when the old gas-works were in the centre of the town, in 1878; and he was sure the citizens were proud of the fact that the Company had always grown and kept pace with the requirements of the town. The work, too, had been carried to a successful issue by local men and local capital. It had given the people an opportunity of investing their money, from which they had received a very fair remuneration. There was another undertaking in the town in which he was officially interested; but despite the fact that contests had naturally taken place between them, the two undertakings had got on well together. This was due, to a large extent, to the tact and good judgment of their Chairman, Mr. Delves. As far as the Gas Company was concerned, he believed it had a great future before it; and there was no reason whatever why it should not continue to be as successful as had hitherto been the case. He trusted, with them, that Mr. Delves and the others actively connected with it might be long spared to conduct its operations in the same admirable way in which they had been managed in the past.

Mr. DELVES, in acknowledging the compliment, expressed his pleasure that they had been interested in looking through the works. The manufacture of gas had evolved from a rule-of-thumb method to a very scientific process; and those who had to do with it had to be chemists as well as engineers. He cordially reciprocated Mr. Cripps's remarks, and trusted that both undertakings would continue to live in harmony. He also trusted, with Mr. Cripps, that the Gas Company would continue to prosper; and he saw no reason why this should not be the case, because gas had become more popular than ever. There had, indeed, never been a year yet during the fifty years he had been connected with the Company that it had not made progress.

The company then separated.

RELATIVE EFFECTS OF GAS AND ELECTRIC LIGHT ON THE PURITY OF AIR.

By G. STANLEY COOPER, B.Sc.

WITH the introduction of metallic filament lamps in electric lighting and the high-pressure system in gas lighting, competition between the two industries concerned has enormously increased. Supporters of both sides have advanced numerous arguments on behalf of their own system; and the question has been considered from many standpoints. Not by far the least important of these arguments is one which deals with the relative effects of the two systems of lighting from a health point of view; and in this article, what to the majority of readers will be a new side of the matter is opened up.

The electrician is continually telling us of the enormous advantages of electric light—its cheapness [?], handiness, and cleanliness. With regard to the last-named quality, coal gas is all that is evil. It is dirty and unwholesome; its products of combustion are harmful to human beings, furniture, &c., and render the air of a room foul. This fouling of the air is due to the production of carbon dioxide in large quantities by the burning of coal gas; and this is in itself a sufficient reason (to the electrical advertiser) to cast out gas and use electric light. The great increase in the number of gas-fires in recent years would not have been, were it not for the ignorance of the user.

It was in connection with the chemical side of the question—viz., the purity of air—that the investigation described in this article was undertaken. The results were so striking that the technical aspect was considered also and deemed worthy of publication. The experiments performed were: To find the amount of carbon dioxide present in a well-ventilated room—(A) when lighted by electricity and (B) when lighted by gas. It is essential, of course, to specify that the room should be ventilated scientifically—that is to say, the fresh air should have an inlet near the floor and the bad air an exit near the ceiling. It has also to be borne in mind: (1) That heated air rises; and (2) that carbon dioxide, though much heavier than air at the same temperature, is much lighter than air when there is a sufficient difference of temperature between them. In other words, carbon dioxide produced at a gas-burner is lighter than the surrounding air.

The experiments were performed in a room 14 feet long, 12 feet wide, and 12 feet high (approximately); having one door and two windows. It contained two grate ventilators—one 8 inches from the ground and the other the same distance from the ceiling—on opposite walls of the room. The lights used were a tantalum lamp and an upright incandescent gas-lamp of approximately the same candle power, as registered by a shadow photometer. The gas was obtained from a wall-bracket, so arranged that each light could in turn occupy almost identically the same position. Two operators were in the room the whole time; and as far as possible all conditions were kept equal for the two tests.

The room was closed for three hours in each case, and several bottles of air were then taken and analyzed. The air had been previously tested for carbon dioxide, and the amount noted. The method of estimation employed was the standard Pettenkofer method. The air to be tested was blown into a bottle of known capacity; and a quantity of barium hydrate (of known strength) was then introduced and the bottle immediately closed. It was shaken for some time, and any carbon dioxide present was absorbed by the barium hydrate, and precipitated as barium carbonate. A quantity of the liquid was then withdrawn from the bottle and titrated against standard oxalic acid. Two or three titrations were performed each time; and the mean amount of acid used was noted. From these results was calculated the percentage of carbon dioxide in the air.

The experiments were performed under the same conditions with both lights; and the results were as follows:—

ELECTRIC LIGHT.

Percentage of CO_2 at commencement	= ·064
,, ,, after three hours	= ·218
Net increase per cent.	= ·154

GAS LIGHT.

Percentage of CO_2 at commencement	= ·071
,, ,, after three hours	= ·203
Net increase per cent.	= ·132

The striking thing about the experiments is that there was actually less carbon dioxide in the room when gas was burning than when electric light was employed. This is perhaps due to the fact that an incandescent flame raises the temperature of the atmosphere around it much more than an electric light does. This being so, a better circulation of air in the room would necessarily follow, and hence the carbon dioxide would be more readily removed through the ventilator.

COAL STATISTICS FOR 1909.

IN the last issue (p. 631) there were set forth some particulars in regard to the output and price of coal in the United Kingdom during the year 1909, taken from Part III. of the Home Office Report on Mines and Quarries. To-day, some other statistics in this Blue-Book may be noted.

The quantity of coal exported (exclusive of coke and patent fuel, and of coal shipped by steamers engaged in foreign trade) was 63,076,799 tons, as compared with 62,547,175 tons in the preceding year—an increase of about 500,000 tons. In 1907, the exports were 63,600,947 tons; and in 1906, 55,599,771 tons. The declared value of last year's exports of coal was £35,319,070, and of those of the preceding year £39,546,169. In addition to this, there was in 1909 the equivalent of 1,936,043 tons of coal exported in the shape of 1,161,626 tons of coke, and of 1,310,257 tons in the form of 1,455,842 tons of manufactured fuel. If to this be added the 19,713,907 tons of coal shipped for the use of steamers engaged in foreign trade, there is arrived at a total quantity of coal and coal equivalent shipped of 86,037,006 tons. The declared value of the exports of coke was £836,570, and of manufactured fuel £974,338. The coal equivalents are ascertained by assuming that for every 60 tons of coke exported, 100 tons of coal were consumed in its manufacture. The manufactured fuel exported is computed to contain 90 per cent. of coal; the remaining 10 per cent. consisting mainly of pitch.

Perhaps a moment may be spent in glancing at the list of countries to which this large quantity of coal was exported. Our three biggest customers are as in the preceding twelve months; and they occupied exactly the same relative positions. France took 10,408,010 tons of coal as such, of a value of £5,559,670; Germany, 9,671,992 tons, of a value of £4,548,987; Italy, 9,081,667 tons, of a value of £5,280,915. In the case of France and Italy, these figures would be increased by upwards of 200,000 tons by the inclusion of the coal equivalents taken in the shape of coke and manufactured fuel. The coal, as such, exported to these countries in the three immediately preceding years was as follows: 1908—France, 10,415,430 tons; Germany, 9,646,868 tons; and Italy, 8,742,634 tons. 1907—France, 10,694,136 tons; Germany, 10,107,877 tons; and Italy, 8,317,637 tons. 1906—France, 9,444,528 tons; Italy, 7,810,024 tons; and Germany, 7,629,653 tons. From these figures, it would seem that our exports to the countries named have not varied to any great extent during the past three years. Imports of "coal, culm, and cinders" into the United Kingdom—always of a totally insignificant character—are slightly more in the present statistics than was the case in 1908, though still a good deal below the quantity two years ago. In 1909, the total amount imported was 6318 tons, and the value £8297. For 1908, the tonnage was 3842, and the value £4689; and in 1907, there were 18,834 tons, of a value of £20,845. The Netherlands, with 2696 tons, were last year the largest contributors; the smallest being Hong Kong, with only 20 tons. After

meeting all the requirements from abroad, there remained, of the total output of 263,774,312 tons of coal, 177,737,306 tons for home consumption for all purposes; and reckoning the population of the United Kingdom at 45,005,833, this represented a quantity of 3·949 tons per head—an amount which has only been exceeded (and then by very little) on six occasions since 1873, the date of the first statistics. In 1908, the amount remaining for home consumption per head of the population was 3·956 tons.

Particulars in regard to the making of coke and briquettes, and the number of coking-ovens in use, during the year 1909 show that returns of production of coke were received from 161 colliery owners (comprising 233 separate works), 1436 gas-works, and 14 other owners of coke-ovens (comprising 15 works). The counties of Durham and York furnished 70 per cent. of the total quantity of coke made in coking-ovens; and 69 per cent. of the total number of ovens were being worked in these counties. Of the 248 works (other than gas-works) where coking plant is in use, bye-products were recovered last year at 71; the principal of the bye-products being sulphate of ammonia and tar. Returns as to the manufacture of briquettes were obtained from all firms known to be engaged in the industry; South Wales being by far the largest contributor in this respect. It is remarked in the Blue-Book that very fine slack which would otherwise be of little value commercially is employed in making briquettes. The total quantity of coal used in the manufacture of coke in 1909 is given as 34,514,573 tons; the total amount of coke obtained being 18,867,149 tons (7,370,598 tons from gas-works, and 11,496,551 tons from coke-ovens), of a value of £11,896,913. Of the gas-works output, 6,307,966 tons came from England, 134,068 tons from Wales, 773,526 tons from Scotland, 145,307 tons from Ireland, and 9731 tons from the Isle of Man. Of the 24,182 coke-ovens in use, 17,393 were of the beehive pattern; the second and third in order being: Coppée, 1959; and Simon-Carvés, 1143. Of Otto Hilgenstocks there were 948, of the Semet-Solvay pattern 842. There were produced 1,511,645 tons of briquettes, which were valued (selling price at place of manufacture) at £978,498.

Before leaving the Blue-Book, we may turn for a minute to some of the materials other than coal which are, or have been, embraced in the subject with which the report deals—namely, the mineral output, and exports and imports, of the United Kingdom. A substantial decrease is shown on the present occasion in the output and value of the bog ore taken from open workings in Ireland; the figures being 2676 tons, of a value at the open works of £669, as against 4295 tons, of a value of £1074, in 1908. During the period since 1880 (over which figures are given in the statistics), the greatest output was in the year 1891, when it was 16,075 tons, of a value of £8037. The output of iron ore last year was 14,979,979 tons, valued at £3,689,777. This was 51,046 tons less than in the preceding twelve months. During the year 1909, the Blue-Book tells us, the amount of natural gas obtained at Heathfield was 236,800 cubic feet, of which 81,850 cubic feet were used for lighting the local railway station, and the remaining 154,950 cubic feet were supplied to the East Sussex Gas and Water Company. It may be pointed out that in 1904 the quantity of natural gas obtained at this much-advertised spot in Sussex was 774,800 cubic feet; so that the business does not strike one as being of a growing character. The output of oil shale from mines and quarries in the United Kingdom during 1909 (all of which was from Scotland, with the exception of 40 tons from the county of Stafford) was 2,967,057 tons, of a value of £815,937; the figures for 1908 being 2,892,039 tons, of a value of £795,257. Since 1906, no petroleum has been obtained. Last year the imports of petroleum amounted to 358,102,867 gallons, of a value of £6,121,202, compared with 343,613,048 gallons, value £6,662,811, during the preceding year. The sources of supply were: Russia, 27,824,129 gallons; the United States, 268,532,909 gallons; and other countries, 61,745,829 gallons. Once more we see a falling off in the Russian supply, which, however, is more than counterbalanced by the greater quantity derived from the United States. The imports from Russia in 1904 amounted to 129,599,066 gallons, compared with the 27,824,129 gallons of last year. The value of imports during 1909 is given as: Russia, £535,792; the United States, £4,190,779; other countries, £1,394,631.

THE LATEST GAS UNDERTAKINGS RETURNS.

Official Figures as to Gas Supply.

THE returns relating to the gas undertakings of the United Kingdom for the year ended Dec. 31, 1909, in the case of Companies, and March 31, 1910, for the Local Authorities, were issued yesterday—having been ordered for printing on the 15th of November only. The immediately preceding returns were published on the corresponding day last year; the order for printing having been given on the 4th of November. This, as readers are aware, is a great improvement on past years. The number of pages occupied by the returns is the same as before—101 pages for the Companies and 59 for the Local Authorities.

Information is furnished in reference to 794 undertakings this year, compared with 790 before. The new comers among the 501 Companies are Ammanford, Blackwood, Hayfield, Rainford, Tawe Valley, Woolmer, and Fermoy; but the Hailsham, Prestatyn, Wath-upon-Dearne, Western Valleys, and Ystalyfera Companies drop out. Among the 293 Local Authorities, there are two new comers—viz., the Risca Urban District Council and the Tayport Corporation. The total capital authorized (including other purposes than gas supply in certain cases) is given as £154,500,093, of which £132,123,284 has been paid up and borrowed. For the Local Authorities, the capital authorized is £46,474,744, and the amount borrowed £42,002,322. In the case of the Companies, the figures are: Amount authorized, £108,025,349, being £86,156,331 share and £21,869,018 loan capital; amount paid up and borrowed, £90,120,962. The receipts are: Companies, £19,951,779; Local Authorities, £10,398,263—a total of £30,350,042.

The statistics relating to working show that 15,225,320 tons of coal were carbonized; the quantity of gas produced being 193,547,394,000 cubic feet, of which 177,686,943,000 cubic feet were sold. The total make includes 23,625,186,000 cubic feet of water gas and 99,792 cubic feet of acetylene gas. The totals in the preceding returns were: Coals, 15,394,307 tons; gas made, 189,918,737,000 cubic feet; gas sold, 173,957,395,000 cubic feet; water gas made, 21,628,862,000 cubic feet; acetylene gas made, 93,500 cubic feet. At the date to which the latest returns were made up, there were 35,230 miles of mains in use to supply 6,164,066 consumers and 712,903 public lamps. The preceding figures were: Miles of mains, 34,490; gas consumers, 5,916,120; public lamps, 700,696.

Comparing the figures furnished by the present returns with those contained in similar returns for the previous nine years, it will be seen that the Companies show as follows:—

Year.	Share and Premium Capital Paid Up.	Loan Capital Issued.	Receipts.	Expenditure.
1900. . .	£59,638,877	£11,775,642	£17,638,963	£13,864,808
1901. . .	62,775,845	12,201,533	17,955,187	14,537,797
1902. . .	64,299,112	12,829,925	17,205,002	13,167,186
1903. . .	67,417,798	13,451,381	17,756,626	13,214,322
1904. . .	68,953,306	13,775,734	17,828,872	13,397,727
1905. . .	70,605,726	14,176,599	17,617,598	13,410,307
1906. . .	72,008,451	14,467,842	18,166,087	13,671,369
1907. . .	73,152,891	14,645,271	19,567,336	14,884,982
1908. . .	74,328,645	14,944,060	20,013,159	15,475,933
1909. . .	74,952,664	15,168,298	19,951,779	15,097,658

Year.	Tons of Coal Carbonized.	Cubic Feet of Gas Made.	Number of Consumers.	Public Lamps Lighted.
1900. . .	8,426,853	94,869,749,232	1,945,825	326,813
1901. . .	8,580,365	97,386,618,553	2,048,359	326,209
1902. . .	8,520,004	99,676,048,000	2,197,987	333,308
1903. . .	8,528,823	101,490,084,000	2,385,348	335,363
1904. . .	8,673,343	105,311,980,000	2,588,917	343,908
1905. . .	8,722,145	109,823,682,000	2,813,156	350,113
1906. . .	8,922,781	114,528,923,000	3,023,619	356,070
1907. . .	9,240,280	118,699,705,000	3,230,993	362,986
1908. . .	9,281,738	119,985,109,000	3,399,193	367,950
1909. . .	9,175,532	122,930,431,000*	3,573,796	369,882

* Including 18,345,916,000 cubic feet of water gas. Number of cubic feet sold, 112,331,153,000.

The somewhat similar figures for the Local Authorities are—

Year.	Amount Borrowed, including Annuities (not deducting Repayments).	Receipts.	Expenditure (exclusive of Amount in the next Column).	Interest, &c., Paid.*	Net Profit after Payment of Items in preceding Column.
1900-01 .	£31,509,701	£9,121,418	£7,463,693	£1,353,259	£409,802
1901-02 .	34,045,442	9,300,567	7,630,856	1,467,232	414,091
1902-03 .	35,738,023	9,554,984	7,215,502	1,584,985	793,764
1903-04 .	37,103,279	9,819,685	7,182,008	1,700,405	967,194
1904-05 .	38,512,295	9,546,682	7,052,474	1,738,682	790,450
1905-06 .	39,401,896	9,636,107	7,085,710	1,799,094	798,210
1906-07 .	40,089,167	9,843,243	7,211,987	1,843,122	832,341
1907-08 .	40,712,159	10,500,416	7,839,122	1,882,427	827,454
1908-09 .	41,435,988	10,506,480	7,998,776	1,905,810	659,445
1909-10 .	42,002,322	10,398,263	7,710,985	1,970,241	767,961

* These figures include: (1) Interest paid on loans; (2) amount paid for annuities; (3) amount of loans repaid; (4) amount paid for redemption of annuities; (5) amount placed to sinking fund.

Year.	Tons of Coal Carbonized.	Cubic Feet of Gas Made.	Number of Consumers.	Public Lamps Lighted.
1900-01. .	5,479,435	57,138,062,255	1,767,464	278,343
1901-02. .	5,522,264	59,300,273,086	1,872,633	287,887
1902-03. .	5,589,215	60,902,739,000	1,970,738	294,828
1903-04. .	5,673,013	62,717,759,000	1,945,777	301,308
1904-05. .	5,622,259	63,335,696,000	2,148,260	310,275
1905-06. .	5,758,180	65,081,109,000	2,250,919	315,678
1906-07. .	5,923,476	67,312,153,000	2,339,914	321,910
1907-08. .	6,166,473	69,786,988,000	2,434,183	327,278
1908-09. .	6,112,569	69,933,629,000	2,516,927	332,746
1909-10. .	6,049,788	70,616,963,000*	2,590,270	343,021

* Including 5,279,272,000 cubic feet of water gas and 99,792 cubic feet of acetylene gas. Number of cubic feet consumed, 65,352,790,000.

The returns furnish, as usual, particulars in regard to the nature and quantity of materials other than coal used for the manufacture of gas, and also give the percentages of carburetted water gas mixed with the coal gas sent out for consumption. These statistics will be dealt with next week.

CARBONIZATION.

By Dr. Harold G. Colman.

[A Lecture delivered at the Manchester University last Saturday.]

The subject on which I have been asked to lecture to-day—namely, "Carbonization"—is so wide in extent that it is impossible within the limits of a lecture to consider the matter exhaustively. I therefore propose to confine myself chiefly to its chemical aspects, although it will be admitted that the mechanical and economical aspects are of the utmost importance, and that for a full consideration of this, as of all other technical subjects, each of these sides ought to be given due weight.

Coal Carbonization and the Results.

The term carbonization is employed technically as representing the process involved in the destructive distillation of carbonaceous matter for the production from it of combustible gas, coke, and liquid products. The gas is the primary product aimed at in the gas industry, the remainder being bye-products; while in the coke-oven industry the coke is the primary product required, and the gas a bye-product. The aim of those who are concerned with the manufacture and distribution of a public supply of gas, capable of being employed for the production of light, heat, or power, is to carry out the distillation of coal in such a manner as to obtain from it, at low cost, in the form of combustible gas, the maximum proportion of heat units present in the coal, with the proviso that this gas shall only contain a limited quantity of inert gases, and that, so far as practicable, it shall be of uniform composition and calorific power. The illuminating power of the gas when burnt in open flames, which was formerly the matter of greatest import, is now only of minor concern, owing to the adoption of the incandescent burner and the great development in the use of such gas for purposes of heating, cooking, and power production.

The changes which take place when coal is heated in the absence of air are, as is well known, exceedingly complicated in character, and result in the production of many thousands of different substances—some gaseous, some liquid, and some solid at the ordinary temperature; and both the nature of these substances and their relative amounts vary greatly according to the temperature to which the coal is heated, and to the manner in which the heat is applied. Our knowledge of the nature of the reactions occurring during the process is still very far indeed from complete; and it is only possible as yet to consider these changes in very broad outline from a chemical point of view.

Gas-Making Coals.

Coal consists essentially of carbon, hydrogen, and oxygen; but it always contains, in addition, varying quantities of ash, and smaller amounts of nitrogen and sulphur. For gas-making purposes, bituminous caking coal is employed in the great majority of cases—*i.e.*, a coal yielding a large proportion of gas, and which, on heating, first becomes semi-fused and plastic and coalesces, and then undergoes carbonization, in which case the coke produced is quite different in shape from that of the original coal; such coke commanding a higher price than that obtained from non-caking coal. In the coke industry, where the coke is the primary (and not a bye) product, it is even more important that the coal used should have good caking properties.

The following analysis expresses the elementary composition of a sample of gas coal of good quality:—

Carbon	80·10 per cent.
Hydrogen	4·88 ,,
Oxygen	8·89 ,,
Nitrogen	1·24 ,,
Sulphur	1·16 ,,
Ash	3·73 ,,

Action of Heat on Coal.

In considering the action of heat on coal, it will be convenient to deal first with the carbon and hydrogen only (these being the most important constituents from the gas-making point of view), and to leave the consideration of the fate of the other elements until later. When coal is heated above its decomposition point in closed vessels, it splits up into two portions—(1) a solid non-volatile portion, and (2) a volatile portion, partly liquid and partly gaseous at the ordinary temperature. It is an invariable rule that the volatile portion, as a whole, contains more hydrogen and less carbon than the original coal, and that the reverse is the case with the solid residue. When the temperature employed is the lowest at which decomposition of the coal occurs (about 300°-400° C., or 570°-750° Fahr.), it is found that the volatile portion consists mainly of hydrocarbons which are liquid at the ordinary temperature, and only a small yield of rich gas is obtained, consisting mainly of methane (CH_4), ethane (C_2H_6), and ethylene (C_2H_4), with small quantities of hydrogen. The liquid products consist chiefly of hydrocarbons of the paraffin and ethylene series, and of their derivatives—that is, of organic substances relatively rich in hydrogen.

The residue obtained in such a case still contains a good deal of hydrogen, and burns in the air with production of flame, but not of smoke. Where the chief product required is a residue of this kind containing hydrogen, or where the tar is the product of greatest value, as in the Scotch shale-oil industry, low temperatures such as this may be advantageous; but where gas is the first consideration, the yield of gas, although high in calorific power, is relatively very small in volume, and for such purpose higher temperatures must be employed. It should, however, be said that Professor Armstrong, in his paper read before the British Association this last autumn, advocated low temperature carbonization even from the gas-making point of view; but I am quite unable to agree with him in this respect, particularly from a mechanical and economical standpoint.

What Goes on in the Retort.

When the retort is heated to a greater extent, the coal charged into it only rises in temperature gradually, and first undergoes the above low temperature decomposition. The further action of the heat then brings about new changes, both in the above hydrogen-containing residue and in the volatile matter first produced; and although these changes are taking place simultaneously, it is most convenient to consider them separately. The effect of further heat on the low-temperature coke is to eliminate further quantities of hydrogen, which at a dull, red heat is mostly evolved as methane and free hydrogen. At such a temperature a considerable additional quantity of hydrogen is given off, and the coke becomes harder and denser. But even then the elimination of hydrogen is incomplete, and on raising the temperature to the highest attainable in practice, an additional yield of gas is obtained, still consisting of methane and hydrogen. But as the temperature increases, the amount of methane falls and that of hydrogen rises. It follows, therefore, that the higher the temperature to which the residual coke is finally heated, the greater is the yield of combustible gas.

Let us turn now to the further action of heat on the volatile products first evolved, which, as mentioned above, are of but little use to the gas maker, consisting largely of the vapours of petroleum-like hydrocarbons. When the retort is more highly heated—say, to dull redness—these petroleum-like products undergo further decompositions if they are subjected to the action of the heat before they can escape from the retort, yielding a still more volatile portion, consisting of substances which are gases at the ordinary temperature; the most important of these being hydrogen, methane, ethylene, and benzene. The latter, it is true, is a liquid at the ordinary temperature; but it is so volatile that most of it remains in the gas.

On the other hand, simultaneously with the formation of these gases, the petroleum-like products yield many substances that are less volatile than themselves, consisting of hydrocarbons of the aromatic series, such as benzene, naphthalene, anthracene, and their derivatives, which contain a higher percentage of carbon and a lower percentage of hydrogen than is present in the substances from which they are formed. These are liquids at the ordinary temperature, or, if solid (like naphthalene and anthracene), are soluble in the other liquids and condense together as a moderately fluid tar in the subsequent cooling of the gas. By subjecting the primary volatile products to such a temperature, therefore, the yield of permanent gas is largely increased, and that of the tar diminished, and the latter now consists chiefly of aromatic, instead of fatty, organic derivatives—making the tar of especial value for the coal-tar colour industry.

If, however, the volatile products are subjected to still higher temperatures before escaping from the retort—such as a bright red or white heat—further decompositions takeplace, which, on the whole, are by no means favourable to the production of gas. The tar vapours of the aromatic series undergo further decomposition into still denser hydrocarbons, and a gas consisting mainly of hydrogen; and many of the new hydrocarbons formed are solid even at a red heat, and are quite insoluble in the remaining liquid tar. These are partly deposited on the heated walls as "carbon" or "scurf," and are partly carried away with the hot gas as finely-divided particles, and separate on cooling with the tar, making this much more viscous even when hot. Further, even the gaseous compounds undergo additional decomposition; the benzene undergoing partial conversion into hydrogen and denser hydrocarbons, the ethylene yielding some hydrogen and methane, as well as tarry matter, and even the more stable methane undergoes partial decomposition into its elements hydrogen and carbon.

The Maximum Yield.

The chemical considerations, therefore, lead to the conclusion that while, in order to obtain the maximum yield of gas from coal, it is advisable to subject the latter finally to as high a temperature as possible, so as to drive off the volatile matter as completely as may be, the gases and vapours produced in the distillation should only be subjected to a considerably lower temperature than that to which the coke is eventually heated, as too high a temperature results in the separation of carbon, which would otherwise have remained in the gas—thus depreciating both its calorific and its illuminating power. On the other hand, it is equally evident that these volatile products must not be subjected to too low a temperature; for in that case the hydrocarbons, &c., produced in the early stages of distillation would not be sufficiently decomposed, and would be lost from a gas-making standpoint—being condensed in the tar.

Fate of other Constituents.

Now let us consider the fate of the other constituents of the coal during carbonization—oxygen, nitrogen, and sulphur. The ash, of course, remains in the coke, and need not be further considered here. Oxygen is present in considerable amount in the coal-substance; and the coal as used also always contains either

moisture in the free state or in such a loose state of combination that it is given off at temperatures below 100° C.—the amount varying usually from 1 to 4 per cent. The oxygen in the coal substance is probably evolved in the early stages to a considerable extent as volatile compounds of carbon, hydrogen, and oxygen; and these, on further heating, are largely decomposed, forming steam, carbonic oxide, and carbon dioxide. As the temperature rises, the carbon dioxide tends to combine more and more with the red-hot carbon present, undergoing reduction to carbonic oxide; and the steam tends also to act on the carbon, with production of water gas. The higher the temperature to which the gases are heated, more especially while in contact with the coke, the greater is the amount of carbonic oxide formed, and the higher also the amount of steam converted into water gas. Some of the oxygen is found in the tar as compounds with carbon and hydrogen, such as phenol; but the bulk of it remains as steam, which condenses out on cooling, and, roughly, about one-fourth is found in the gas as oxides of carbon.

The effect on the nitrogen is similar to that on the hydrogen. At very low temperatures some ammonia is given off, and also substances containing carbon, hydrogen, and nitrogen, which condense in the tar; while a large proportion of the nitrogen remains in the residue. At higher, but still moderate, temperatures, much more nitrogen is given off from the coal, and the above volatile products are largely broken up, with the formation of ammonia and some free nitrogen; and at such temperatures the maximum yield of ammonia is obtained. At still higher temperatures, more nitrogen is evolved from the coke; but the ammonia itself is largely decomposed into its elements, nitrogen and hydrogen, and also reacts with the hot carbon, producing hydrocyanic acid; and, in spite of the more complete elimination of the nitrogen from the coke, the yield of ammonia is decreased. Some of the nitrogen is also found in the tar, chiefly in the form of nitrogenous bases, such as pyridine.

The sulphur, too, probably comes off first as compounds with carbon and hydrogen; and these, when more strongly heated, yield sulphuretted hydrogen, which can be removed from the gas without much difficulty. At still higher temperatures, however, the decomposition of these volatile organic sulphur compounds takes place, with formation of larger quantities of carbon bisulphide; this compound being also produced, but probably in much smaller amount, in the gases last driven off from the coke, due to the sulphur still remaining in the latter. The high temperature, especially if allowed to act fully on the volatile products, therefore tends to considerably increase the amount of this impurity, which can only be removed with difficulty.

Both with regard to sulphur and nitrogen, therefore, as well as in the case of the hydrocarbons, it is desirable that the volatile products themselves shall only be heated to a moderate temperature if a maximum yield of the valuable product (ammonia) and a minimum yield of the deleterious impurity (carbon bisulphide) are to be obtained. In the case of the oxygen compounds alone does there appear to be any advantage in subjecting the products to a high temperature, owing to the larger proportion of carbonic oxide and the smaller proportion of carbon dioxide produced, as well as to the larger amount of steam converted into combustible gas. On the whole, the advantages gained in the latter respect are more than counterbalanced by the deleterious action of such high temperatures so far as the hydrocarbons and the nitrogen and sulphur compounds are concerned.

Synthetic Results.

Thus far, the formation of new compounds by decomposition has been mainly considered; and there is no doubt that these changes are the most important. But, in addition, formation of fresh compounds by synthesis from two or more of the products of decomposition also occurs; and a large number of the tar constituents are doubtless produced in this way. So far as the gaseous products are concerned, the formation of carbon monoxide by the action of the dioxide on carbon and the synthesis of water gas within the retort have already been referred to; but, in addition, there is the possibility that methane may also be produced to some extent in the retort, not only by decomposition, but also by synthesis from hydrogen and carbonic oxide in accordance with the equation: $CO + 3H_2 = CH_4 + H_2O$. It is known that this reaction takes place to some extent under certain conditions of temperature in contact with certain substances. For instance, it occurs to a very considerable extent when the above mixture of gases is passed over metallic nickel at 300° C.; but very little investigation has been made of the extent to which such a reaction does, or can be made to, take place in the retort. There is evidence that this synthesis does occur in some degree in the retort; and in view of the fact that methane is the most important of the constituents of the gas, further work on this point is desirable.

From Theory to Practice.

Bearing in mind these theoretical considerations, we may now consider the manner in which the changes take place in the carbonization of coal in the various types of apparatus commonly employed. In the gas industry, except in its very earliest stages and again in recent years, carbonization has almost always been carried out in long, narrow retorts, set horizontally, or at an angle of about 32° to the horizontal, into which the coal is charged all at once in such a manner as to cover fairly evenly the whole of the bottom of the retort, and leave a considerable free space above the coal for the full length of the retort, through which the gas must pass in order to reach the exit pipe or pipes provided at one or both ends. In the main, the nature and the sequence of the chemical changes are identical both in the horizontal and the inclined retort.

The carbonization commences on the outside of the mass—namely, at the bottom and sides—where it is in contact with the heated retort wall, and also at the top, where it is affected by the heat radiated through the free space from the hot crown of the retort. The coal on the outside first becomes pasty and agglomerates, and then undergoes the low temperature decomposition already described; the resultant vapours and rich gas escaping fairly readily into the free space above the coal. Here they are subjected to the further action of heat in two ways—namely, by contact with the heated walls of the retorts, and also by the action of the radiant heat rays which are traversing the free space. The late Mr. William Young pointed out that the action of these two forms of heat is different. In general, the heated surface appears to act fairly equally on all constituents; but the radiant heat has a selective action, and most readily decomposes the molecules which absorb such heat most readily. While this is in itself probably true, recent experience appears to indicate that the extent of the difference is less than Mr. Young believed, and that its influence in practical working is not of very great importance. Whatever is the exact relative effect of the two forms, the net result of their combined action is to raise the temperature of the vapours passing through the free space, and to bring about much change; and the higher the temperature to which the retort walls are heated, the greater is the amount of further decomposition they undergo.

The further action of heat on the pasty mass on the outside of the charge converts this eventually into coke—heat passing simultaneously further into the charge and converting the layer below into the pasty condition, which is assisted by the condensation on these lower layers of some of the tarry matters formed by the decomposition of the hotter layers above; and the extent to which such condensation occurs doubtless has much influence on the physical properties of the resulting coke. This sequence of changes continues until the heat has penetrated to the centre of the mass, and effected its complete carbonization. After the first layer of hot coke has been formed, the gases produced from the interior of the charge, in order to escape from the retort, must not only undergo the ordeal of heat in passing through the free space, but must also pass through the hot layer of coke on the outside of the charge; and the temperature and area of this coke mass constantly increase as time goes on. Further, as carbonization proceeds, the rate at which the gas is evolved decreases, and in consequence its speed through the free space becomes less, and it is exposed to heat there for a greater length of time. From all these causes, the quality of the gas falls off after the first hour, and especially when the carbonization is approaching completion. The percentages of methane, ethylene, benzene, sulphuretted hydrogen, and carbon dioxide steadily diminish as time progresses; that of hydrogen steadily increases; while that of carbonic oxide varies less considerably.

Low Temperatures *v.* High Temperatures.

Before the introduction of gaseous firing, the retort temperatures obtained in practice did not usually exceed about 900° C., or 1650° Fahr. Under these conditions, the volatile products were not materially overheated, and gas of high illuminating power was produced; while the tar simultaneously formed was fairly fluid, and only contained moderate amounts of the objectionable "free carbon." The quantity of naphthalene formed was also not excessive, and that of "light oils" simultaneously produced was in most cases sufficient to wash the naphthalene out of the gas during condensation to a sufficient extent to prevent its subsequent deposition in the solid state in the mains and services. On the other hand, under these conditions a relatively low yield of gas per ton is obtained, as an appreciable quantity of volatile matter is left in the coke.

When, with the aid of gaseous firing, higher carbonization temperatures were employed, matters were considerably modified, as the volatile matter of the coal was more completely evolved with the production of a greater volume of gas. But, as we have seen, it follows inevitably that, in a horizontal or inclined retort having a large free space above the coal, the volatile products must also be more strongly heated by an increase in the retort temperature; and, as a result, we find that, under these conditions, the gases and vapours undergo a more far-reaching decomposition than before, and a reduction in the quality of the gas is brought about. Some of the hydrocarbons formerly present in the gas are now deposited in solid or liquid form, which either remain in the retort as carbon or are condensed with the tar, and are lost from a gas-making point of view. Simultaneously other disadvantageous changes occur, inasmuch as the tar produced is thicker and contains much more "free carbon," thereby increasing the trouble from stopped ascension-pipes and pitched hydraulic mains, and greatly increasing the practical difficulties of retort-house working. Further, the action of these high temperatures on the volatile products increases the production of naphthalene and decreases that of light oils, and renders the cooled gas much more liable to deposit solid naphthalene in the mains and services both on the works and in the district, causing serious trouble both to supplier and consumer.

In spite of these last-named drawbacks, the use of higher temperatures has, on the whole, proved favourable; the increased

yield obtained from the more complete elimination of the volatile matter of the coal having more than counterbalanced these disadvantages. But even admitting that in the employment of high carbonization temperatures, the advantages more than balance the disadvantages, the fact remains that there are considerable objections to the process as it stands, and that it is desirable to find a method whereby the coal itself can be heated to a high temperature without simultaneously causing too great heating of the volatile products; and it is largely with a view to this end that modifications of methods of working have been introduced during the past few years.

Advantages of the Smaller Free Space.

From what has been said, it is clear that one of the chief causes of the overheating of the gases and vapours is the existence of a large free space above the coal in the retort. So long as the coke had to be extracted by a rake, worked either by hand or mechanically, a considerable amount of free space was necessary in order to afford room for the introduction of the rake-head above the coke. But the invention of mechanically propelled pushers, which discharge the coke by pushing from one end of the retort, has done away with the necessity of the free space for the removal of the coke, and has made it possible to put in a much larger charge of coal without increasing the difficulties of discharging the latter. In recent years, therefore, by the introduction of such increased charges, the amount of free space has, in many works, been largely reduced in horizontal retorts, so that the gases and vapours are exposed to a smaller amount of retort surface, and, still more important, owing to the volume of the free space being smaller, they pass through it more quickly, and are exposed to the action of the heat for a shorter time. As the practical result, it is found that the coke produced is larger, a thinner tar containing less free carbon is produced (owing to the lessened over-heating), less carbon bisulphide is produced, less trouble from naphthalene ensues, and retort-house working is considerably facilitated. Whether the total heat value of the gas obtained from a ton of coal—*i.e.*, gas per ton × calorific power—is greater than can be obtained with the smaller charges, is a matter on which different opinions prevail at present.

On the other hand, owing to the increased thickness of the charge, a longer period must be allowed for its carbonization if the central core is to be completely carbonized; and beyond a certain weight of charge, varying apparently with different classes of coal, the gas production per retort per twenty-four hours falls off, or can only be maintained by increasing the carbonization temperature above that employed with the smaller charges. Such higher temperatures also increase the heat to which the gases are exposed in the free space. But experience seems to show that the effect of such increase is small when the volume of free space is low; in other words that, in bringing about the decomposition of the volatile products, the time during which the gas is exposed to heat is much more important than is the temperature of the retort walls.

Carbonizing in Retorts on End.

But, while the amount of free space can be greatly reduced in this manner, it is scarcely practicable to get rid of the free space altogether in horizontal retorts. If, however, the retort is placed in a vertical instead of a horizontal position, this is readily effected; as, in the nature of things, the coal when charged in from the top must completely fill the retort. Although a small amount of free space may be left at the top, matters can be so arranged that the retort walls at this point are not heated to any material extent. Hence during the past few years carbonization in vertical retorts has been attempted to a considerable extent, and is now practised in a large number of works.

Two methods of working such vertical retorts are in use. In the first, or the intermittent, method, represented by the Dessau system, due to Dr. Julius Bueb, the old system of carbonization is adhered to in so far that the coal is charged into the retort all at once and is allowed to remain there until completely carbonized, when the coke is discharged by gravity and the retort refilled with fresh coal. To facilitate the discharge of the coke, the retort is tapered, increasing in size from the top to the bottom; and as the charge is thicker at the latter point, a higher temperature is maintained at this part, with a lower temperature in the upper portions, where the thickness of the charge is less. The result of this arrangement is that with high carbonization temperatures a large yield of gas of good calorific power is obtained; the tar formed being very fluid, and only containing a low percentage of free carbon. At the same time the naphthalene produced is less; and the light oil production is such that the naphthalene is sufficiently removed by the ordinary condensation process without requiring any special subsequent treatment, and the amount of sulphur obtained in the objectionable form of carbon bisulphide is greatly diminished. The coke is also harder and denser.

Passage of Gas through Charge in Dessau Verticals.

In spite, therefore, of very high retort temperatures, the objectionable overheating which occurs under these conditions with horizontal retorts with much free space above the coal, is obviated in these vertical retorts. This is due very largely to the abolition of the free space; but, in addition, other conditions come into play. In the horizontal retorts, after a layer of incandescent coke has been formed on the outside of the charge, all gas produced from the unaltered coal in the centre of the charge must find its way out through this incandescent layer, and thus be subjected to considerable heat. In the intermittent vertical retort, the carbonization also takes place from the periphery inwards; and a layer of incandescent coke is in the early stages formed on the outside. Here, however, the gas produced from the still uncarbonized coal at the centre has two possible paths of escape—namely, on the one hand, through the hot-coke layer, and, on the other, through the central core of uncarbonized or partly carbonized coal which extends to the top of the retort; and such of the gas as travels in this manner would avoid the overheating by the hot-coke layer. Dr. Bueb holds the view that the great bulk of the gas travels through the cool central core; but with this hypothesis, I am unable to agree fully.

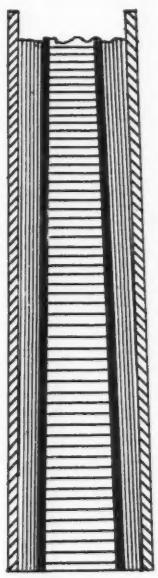


Fig. 1.

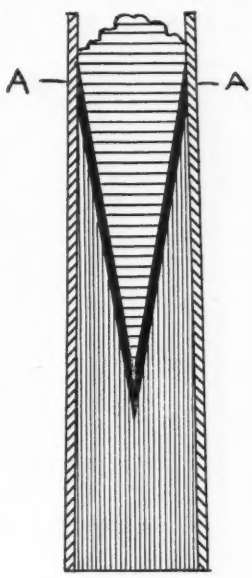


Fig. 2.

Retort Wall shown by Diagonal Lines.
Coal ,, Horizontal Lines.
Coke ,, Vertical Lines.
Pasty Layer ,, Thick Black Line.

In fig. 1 is represented, by a sectional diagram, the condition of affairs which most likely prevails in such a vertical retort when carbonization is partly completed. The heat, penetrating the coal from the periphery, has converted the outer layers into coke, represented by vertical shading; and this is followed by a layer of coal which has assumed a pasty condition, denoted by a thick black line, where some of the tarry constituents formed by the carbonization of the outer layer have also condensed. Beyond this is the central core of uncarbonized coal, represented by horizontal shading. The pasty layer forms a boundary between the coke on the one hand, and the uncarbonized coal on the other, and, owing to its condition, will only with difficulty permit of the passage of gas through it. It would therefore seem probable that any gas produced at or beyond the outer side of this layer will find its easiest passage through the coke; while the gas formed on its inner side will most readily pass up the central core of uncarbonized coal. The determination of the actual proportions of the gas travelling in each of these directions is very difficult, if not impossible; and at present, without some experimental evidence, any estimate of this can only be a hypothesis. But my own view is that probably half the gas finds its way through the coke. On the other hand, the gas produced on the inner side of the pasty layer is the richest and most susceptible to heat; and it is more important that this portion should not be too unduly heated.

Continuous Systems of Working.

In the continuous vertical retorts, which have been chiefly worked out in this country, and are represented at present by the Woodall-Duckham and Glover-West systems, the object aimed at is not only to abolish the heated free space above the coal, but also to render the carbonization process a continuous one by the addition of mechanical arrangements whereby the coke is withdrawn continuously, or nearly so, from the bottom of the retort—fresh coal being added to the retort at the top to take the place of the coke removed. Here the conditions of carbonization remain fairly constant, and the quality of gas produced is approximately uniform, instead of falling off as the carbonization becomes more complete. The condition of things prevailing in this retort remains therefore always nearly the same, and is represented diagrammatically in fig. 2. Here, also, the heat penetrates the mass of coal from the periphery and travels inwards; but as the charge is constantly moving downwards, the uncarbonized coal takes the form of an inverted cone, as shown by the horizontal shading. In this case, too, we have, between the more or less completely carbonized coke and the unaltered coal, a pasty layer, indicated by a thick black line. The gas produced on the outside of this layer, together with that still evolved from the coke, most likely finds its easiest way through the coke to the point A.

If the pasty layer adheres closely to the retort wall at this point, the gas would have difficulty in escaping to the exit-pipe at the top of the retort; but the constant motion of the mass downwards tends to prevent too close adherence, and allows the gas to pass through. The gas formed on the inside of the pasty layer finds its most ready exit through the uncarbonized coal.

Vertical Retort Heating.

In working such retorts, higher temperatures are usually maintained around the upper portions than around the lower end; whereas the reverse is the case with the Dessau vertical retort. But although the retort walls may be hotter at the top, the temperature within the retort is always lowest there, owing to the cooling action of the cold coal coming in. With these continuous retorts, the temperature of carbonization may be very high, and a complete elimination of the volatile matter of the coal obtained without excessive overheating of the volatile products; and, as in the case of the intermittent vertical retorts, the tar produced is thin with a low content of "free carbon," no naphthalene trouble occurs with the gas after condensation, and the carbon bisulphide production is reduced, while at the same time a high yield of gas of good calorific power is obtained.

Large-Scale Charges.

Lastly, brief consideration must be given to the conditions prevailing when the charge of coal is much larger than is the case when retorts are employed, as in coke-ovens, where coke is the primary product desired, and in the somewhat smaller carbonizing chambers now employed for gas-making purposes in many instances, especially in Germany. In these ovens or chambers, the coal is charged in such a manner that the mass to be carbonized lies in a block, from 14 to 20 inches thick, between two strongly heated vertical walls; the length of the mass being as much as 20 feet, and the depth about 8 feet in the case of coke-ovens. The heat is applied to the charge from the side walls only; and it slowly penetrates from each side to the centre of the mass. The sequence of changes is very similar to that occurring in the intermittent vertical retort; coke forming first on the outside of the mass where it is in contact with the hot walls, a layer of coal in the pasty condition coming next, and finally, the uncarbonized coal in the centre. In both cases, too, there is no highly heated free space above the coal. The most important difference is that, owing to the much greater bulk of the charge, the ratio of heating surface to the weight of charge is much smaller than is the case with retorts, and in consequence the rate of carbonization is much slower.

So far as the coke produced is concerned, the effect of this slower rate is to give a denser and harder coke; but where the coal used is of the same quality and size as employed in retorts (which is usually the case with chambers for gas production) the end results, so far as quality and quantity of gas, tar, and ammonia are concerned, do not, according to the published results, appear to be very materially different from those obtained in vertical retorts. The relative advantages and disadvantages of chambers and retorts lie rather in connection with the capital and working costs and in questions as to the desirability of such large carbonizing units as these chambers for making a uniform quality of gas and adjusting the output to the seasonal variation in the requirements for a public supply of gas; and these points it is not possible to discuss this afternoon.

In the case of coke-ovens, where the gas is mostly a secondary consideration, conditions differ in another respect, as, in addition to the requirement that the coke produced must be hard enough for all metallurgical purposes, it is also desired to utilize in its production the slack obtained in mining the coal, which has a lower commercial value than the larger coal. This slack is now usually washed to remove impurities, and when charged into the ovens lies in a close mass, with very small interstitial spaces between the coal fragments, and is sometimes further specially compressed; and, in addition, it contains 10 per cent. or more of moisture. While the result of these factors is to improve the quality of the coke produced, the gas, as it is formed, has greater difficulty in escaping from the centre of the charge, and the volume produced is usually lower, although of good calorific power, excepting where it is diluted by the drawing in of considerable amounts of furnace gas and air.

GAS CALORIMETRY IN THE UNITED STATES.

The American Gas Institute Report.

At this year's meeting of the American Gas Institute, a report of the "Committee on Calorimetry" was read by Mr. John B. Klumpp, who it will be remembered was the author of a paper on the subject presented to the meeting of the Institution of Gas Engineers last June. The report is as follows.

During the last two years your Committee undertook an investigation of the subject of gas calorimetry, with the view of ascertaining the best commercial methods for obtaining the calorific value of city illuminating gas. With this object in view, they obtained calorimeters of the prevailing makes then in use by the gas companies and other gas industries, and undertook to determine the efficiency and general utility value of these instruments. The reports, submitted by your Committees in 1908 and 1909, described in detail the line of investigation undertaken, and the results obtained; and up to this time we have no further knowledge that would tend to modify our conclusions. These conclusions were, briefly, that calorimeters of the water-heater or Junkers type were best suited for our commercial practice; and, when operated under certain prescribed directions, they should give results that could be accepted as the relative calorific value of any gas.

The object of continuing this Committee was for the purpose of investigating any further development in gas calorimetry, as several instrument makers signified their intention to manufacture gas calorimeters differing in principle and design from those now in use. Therefore, it has been the task of your Committee to keep posted in this line of work—not to recommend or condemn, but to advise members of the Institute as to a type of calorimeter best suited for use in the gas industry.

Unfortunately, several very interesting types of instruments were received as late as the first week in September, but the time has been too short for us to conduct experiments that could be presented in full at this meeting.

Professor S. W. Parr, of the University of Illinois, concluded during the past year some experimental work upon the Junkers calorimeter, and submitted the results of his work to the American Chemical Society. His article on the subject was published in the September number of the "Journal of Industrial and Engineering Chemistry." He claims that the Junkers calorimeter gives results too low by from 1 to 4 per cent., when operated with circulating water of the same temperature as that of the air, which he determined by burning pure hydrogen in the calorimeter. These figures are not in accord with the experiments of Hugo Junkers, or of Dr. Immenkotter, and do not agree with our efficiency tests. Professor Parr claims that the errors are due to atmospheric humidity and radiation; and your Committee are not ready to accept his criticisms without further investigation.

Professor Parr has submitted to us a calorimeter of his own design, depending upon the comparison of the unknown gas to be measured with hydrogen of assumed heating value.* This instrument is a duplex calorimeter—one side burning the city gas, while the other side burns the hydrogen. The ratio of the heating value of the gases is determined; and this factor is used to give the value to the unknown gas being measured.

The American Meter Company have produced a gas calorimeter of the same general design and specifications as the Junkers. This instrument is modified, however, so as to have the thermometers on the same level, and is supplied with a gas meter of its own make and a balance for weighing the circulating water. This instrument, with its accessories, is constructed in accordance with the recommendations of your Committee.

The Junkers Company, of Dessau, Germany, have also modified their calorimeter, producing a later instrument with the water thermometers on the same level. The entire outfit is arranged similarly to the original Junkers, although the interior of the calorimeter proper is slightly altered, and the arrangement of the exterior connections somewhat changed. They have also produced a recording calorimeter, mounted in a cabinet, which maintains an even ratio between the gas and water supplied, and records the difference in temperature of the inlet and outlet water, electrically. This instrument is somewhat elaborate, and requires careful adjustment and supervision. But in the larger works it could be made to give very satisfactory results.

During the month of September we received, for experimental purposes, a Doherty calorimeter, from the Improved Equipment Company, of New York—an instrument of the water-heater type, with gas measured by water displacement, the water at the same time being used for jacketing purposes. This instrument is undergoing tests, the results of which are not as yet completed.

We have received word from several other parties who were about completing calorimeters, or have them in view, pending the granting of patents, or completion of design, and who up to the present time have been unable to submit instruments to us. They include the Rotary Meter Company, and Dr. C. E. Lucke, of Columbia College.

While not engaged in active experimental work this year, owing to the lack of instruments to work with, we have consulted with various members of the Gas Institute for the purpose of receiving information in regard to the practice of others, and have in addition been called in consultation with several State Gas Associations, and the Engineers of State Commissions, and have endeavoured to assist and advise in matters pertaining to the correct reading of calorific value of commercial city gas.

Your Committee have been asked by several members of the Institute for concise directions for operating a gas calorimeter, and they refer to the directions in the Calorimeter Report of the "Proceedings of the Institute" for 1908, which go into considerable detail. The 1909 report gives further specifications, especially to thermometers to be recommended for measuring the temperature of the water, which should be graduated preferably from 60° to 110°, instead of 65° to 115°, as stated.

While not in a position at this time to present the results of our experimental work on new calorimeters, we are endeavouring to obtain unbiassed and correct data on such calorimeters as appear on the market; and if our Committee are continued for another year, we will attempt to collect further information for the Institute.

* The calorimeter here referred to was illustrated and described in the "JOURNAL" for Oct. 18, p. 205. It is the subject of a patent applied for in England by Professor Parr, on Jan. 18 last.—ED. J.G.L.

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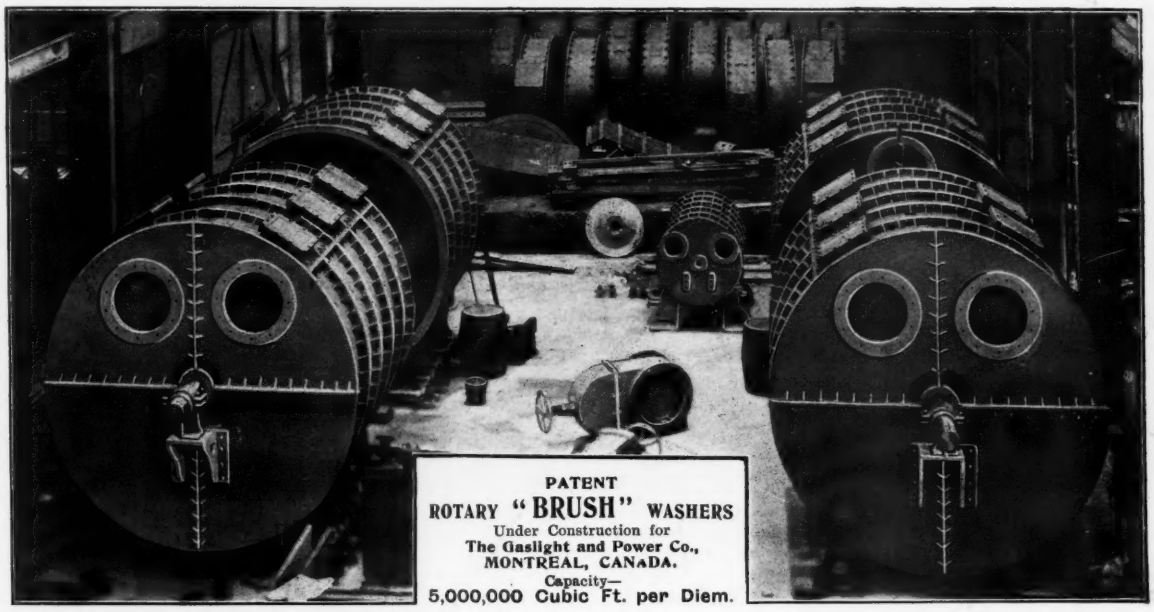

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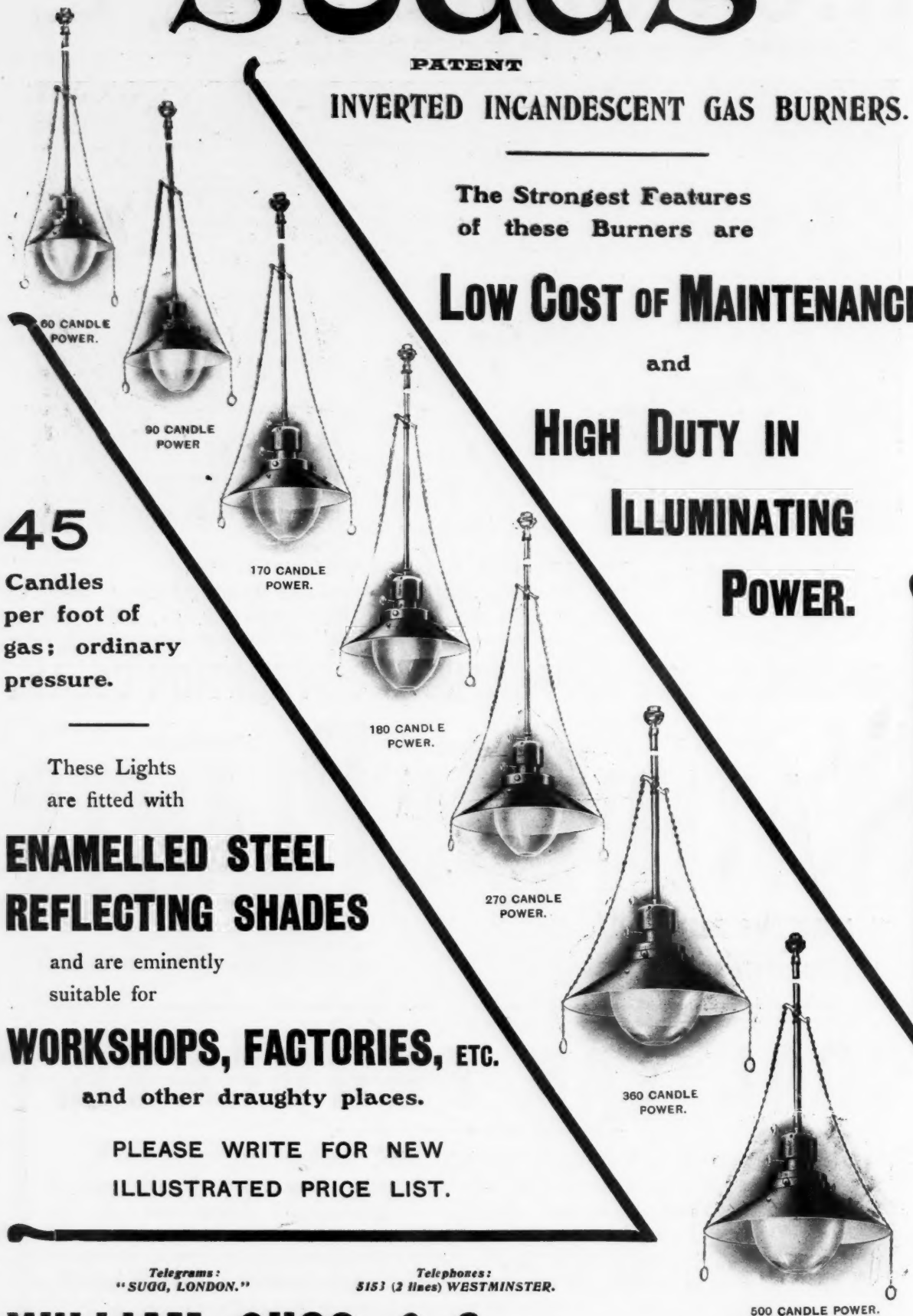

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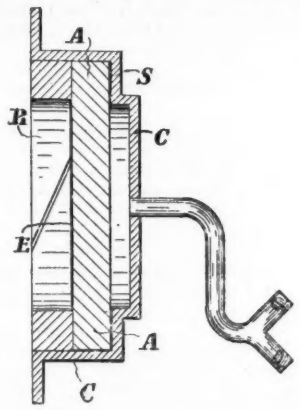
THE COMBUSTION OF GASEOUS FUEL.

The Bone, Wilson, and M'Court Patents.

Last week, specifications were issued by the Patent Office relating to the first two of a series of inventions for which protection was sought by Professor W. A. Bone, of Leeds University, Mr. James W. Wilson (Wilsons and Mathiesons), of Leeds, and Mr. C. D. M'Court, of Balham. The importance of the specifications issued—for patents No. 25,808, Nov. 9, 1909, and No. 29,430, Dec. 16, 1909—justify fuller abstracts than would be allowable in our usual "Register of Patents."

Patent No. 25,808; Nov. 9, 1909.

The first invention referred to relates to apparatus for burning an explosive mixture of two or more gases or vapours which combine together to produce heat—called the "combustible mixture" (such, for instance, as a mixture of coal gas and air, with air in the proportions necessary for complete combustion, or slightly in excess); the objects being to obtain complete combustion and also utilize as much as possible of the heat for any desired purpose. The purposes to which the apparatus may be applied "are numerous, and include gas-fires of various kinds."



The illustration represents a simple form of what may be described as the "fundamental unit" of the apparatus. It consists essentially of a permeable diaphragm A, of sufficiently refractory material, in conjunction with a chamber or casing C. The diaphragm constitutes one wall of the chamber, into which combustible mixture is led through a pipe or pipes. The mixture passes through the diaphragm, and is caused to ignite on the face of the exit E, or in close proximity thereto. For instance, a combustible mixture of coal gas and air in proper proportions and at various pressures (examples of which are afterwards given) may be used for many household and industrial purposes. The supply of gas and air in proper portions is regulated by ordinary means, so that the combustion may take place substantially within the surface layer E of the diaphragm A. The regulation of the supply of the mixture having been adjusted, the face of the diaphragm becomes hot or incandescent, and is maintained in this state by the continued flow of the combustible mixture through the porous diaphragm, and its combustion within its surface layer. The flow can be regulated so that little or no flame appears beyond the surface of the diaphragm while the surface is maintained in a state of glow or incandescence.

With regard to the combustible mixture, the proportions of the combining gases will be substantially the proportions necessary for complete combustion. In general, with coal gas, the patentees prefer to employ a little excess of air. For example, in the case of a coal gas (which theoretically requires about 5½ times its own volume of air for complete combustion) they have obtained good results with about 7 times its own volume of air.

The joint between the diaphragm A and its seating S may be white lead, asbestos paste, or other suitable luting material; and a ring R, or an angle ring, may be used to secure the diaphragm in position. The margin of the diaphragm may be glazed so as to prevent escape of gas through its edges—"no claim being made to this feature except in so far as it affects our particular combination." The diaphragm may be arranged in various ways, depending on the object in view. In some cases more than one diaphragm may be employed. Thus for grilling or toasting purposes, two diaphragms may be arranged opposite one another, and the article to be treated placed between them, so that both sides may be acted on at once. Where plane diaphragms are employed, they may be placed horizontally, vertically, or at any desired angle; and the heated external surface may be either the superior or inferior surface.

In some cases, instead of using plane diaphragms, they employ dome-shaped or cylindrical diaphragms, or diaphragms of other special forms suited to special purposes. It should be noted, however, that where there is, with any particular mixture of gases, a tendency to heat the diaphragm so much as to cause firing-back, the arrangement must be such as to utilize or convey away the heat with sufficient rapidity to prevent such firing-back. For instance, in using water gas there is always a tendency to fire-back; but this may be in a large measure counteracted by employing diaphragms of a closer or less permeable texture, so as to produce a steeper pressure-gradient in the diaphragm—thereby increasing the velocity of flow of the combustible mixture through the diaphragm. Accordingly, it is desirable in any given case to select from a series of diaphragms of different permeabilities the diaphragm which on trial is found to be sufficiently impervious to prevent firing-back under the given conditions. Also the tendency to fire-back may be checked by mixing a larger proportion of inert gas or air with the combustible mixture. Further, where there is risk of firing-back the progressive accumulation of heat in a confined space must be avoided. On the other hand, when using poor gases—as, for example, blast-furnace gas—the production of the glow or incandescence depends on conserving a certain amount of the heat on the surface of the diaphragm.

It should be noted that in the apparatus, though the products of combustion necessarily pass away in a heated condition, and thus carry off some of the heat generated, the arrangement described enables the user, when desired, to reduce the convective heat outflow and to utilize a large proportion of the heat in radiant form by radiation from the surface of the heated diaphragm, which for some applications of the invention is a matter of importance.

The diaphragms may be produced from various materials, either separately or in combination, and may vary considerably in their nature, shape, and construction (examples are hereafter specified). But other constructions in the nature of a diaphragm may be adopted, so long as they enable a mixture of gases or the like on burning to produce within the surface of the medium a combustion with little or no flame.

In the production of the diaphragms, the refractory materials employed are combined so as to give the desired degree of porosity and permeability somewhat in the manner usual in the production of porous refractory blocks. Materials of a nature to burn out and leave pores or interstices may be combined with refractory materials—for example, the patentees have used mixtures of fire-clay with fine seed, bran, and (or) spongy plumbago produced by acting on Ceylon flake plumbago with strong fuming nitric acid and applying heat.

In some cases, two or more diaphragms of differing degrees of permeability or porosity may be combined; such diaphragms being formed into one or superimposed—the more porous diaphragm being that which is on the side of exit of the gaseous mixture. Similarly, granules of refractory material may be spread over a slightly pervious fire-clay diaphragm; the granules forming the side or surface of exit for the combustible mixture.

The degree of porosity will be determined by the quantity of organic material employed. In general, it is preferred to employ fine seed for this purpose, as being a material the individual grains of which are substantially of the same size and shape. The patentees find that rape seed is specially suitable for this purpose. The proportions will vary somewhat with the nature of the clay employed—some clays being by nature when burnt more porous than others; and in every case it is necessary to determine by trial the proper proportions for producing a desired degree of porosity. But the examples given serve to indicate in some measure the nature of the mixtures which are found suitable in practice.

In making diaphragms suitable for working with coal gas and air at a pressure of 6 inches water-gauge, they mix 18 parts by weight of powdered Stourbridge fire-clay in the dry state with 8 parts by weight of English rape seed, and mix therewith sufficient water to render the mixture suitable for moulding. It will be found that the plasticity of the mixture becomes rapidly lost on standing, owing to the absorption of the water by the dry seed. Only sufficient of the mixture should be made to suit immediate requirements; and the diaphragms should be moulded immediately after the mixture is made, and before it has lost its plasticity. To obviate in part the loss of plasticity mentioned, the rape seed may be steeped in water prior to mixing with the clay. The moulded diaphragms are carefully dried, baked, and burned in an oxidizing atmosphere, so as to ensure the complete burning out of the seed. After burning, the surface of the diaphragm which is to form the heated surface is preferably roughened with a rasp, sand blast, or by other means; or both surfaces of the diaphragm may be roughened.

By employing the proportions mentioned, diaphragms have been made which, when ¾ inch thick, are able, at a pressure of 6 inches water-gauge, to admit of a flow per square inch of heating surface of 6·4 cubic feet per hour of a gaseous mixture consisting of one volume of gas with six or seven volumes of air.

By employing a mixture consisting of 18 parts by weight of dry, powdered Stourbridge fire-clay with 12 parts by weight of English rape seed, diaphragms have been made which, when ¾ inch thick, admit of the same gaseous flow at a pressure of 1 inch water-gauge.

Another method of making porous diaphragms consists in consolidating a mass of granules or fragments of refractory material in such a manner as to leave pores or interstices throughout the mass. For example, burnt fire-clay coarsely ground (and preferably meshed to a uniform size), mixed with a powder adapted to act as a cementing material, when highly heated, may be moulded in the form of diaphragm required, and burned. Thus, for working at a pressure of about ½ inch water-gauge, with a mixture of

coal gas and air, the grade of fragments employed is that which passes through a sieve of eight meshes to the linear inch, but will not pass a sieve of sixteen meshes. These fragments are wetted, mixed with one-tenth their weight of finely-ground felspar, and moulded into the form of diaphragm required; slight pressure only being used to give the diaphragm the desired configuration, and burnt at a temperature of 1300° or 1400° C. A series of such diaphragms, made with differing degrees of fineness, can be used to determine which is the best grade to use for any particular gaseous mixture.

The patentees conclude their specification by saying: We are aware that it has been proposed to construct burners in which a mixture of gas and air is passed through a body of porous refractory material in close proximity to a flame, but separated therefrom by a mantle of loose refractory material or by a perforated plate; and they claim: (1) Apparatus for the burning of an explosive mixture of gases arranged so that a regulated flow of the explosive mixture through a porous diaphragm can be maintained in such wise that combustion takes place substantially within the outer surface layer of the diaphragm, which outer surface layer is thereby maintained in a state of incandescence. (2) The combination of a permeable refractory diaphragm with a suitable chamber and means of regulation, so that an explosive mixture of gases may be burned substantially without flame within the surface layer of exit of the diaphragm. (3) In apparatus as claimed in Claim 1 a porous diaphragm made by mixing a plastic refractory substance, such as fire-clay, with a suitable oxidizable material such as rape-seed, moulding to the desired shape, and firing substantially as described. (4) In apparatus as claimed in Claim 1 a porous diaphragm made by crushing and grading a suitable refractory solid material such as burnt fire-clay, and consolidating it into a porous mass. (5) In apparatus as claimed in Claim 1 a porous diaphragm made as in Claim 3 or Claim 4, and having its edges rendered impervious to gases by glazing or its equivalent.

Patent No. 29,430; Dec. 16, 1909.

This invention relates to means for utilizing the accelerating influence of an incandescent solid upon gaseous combustion (such means being a development of patent No. 25,808 *supra*) in such a way as to enable a large proportion of the heat of combustion to be utilized at a high temperature—in a space which is more or less enclosed—in a variety of furnaces applicable to a number of industrial or laboratory operations.

A mixture of combustible gas or vapour—*e.g.*, coal gas—and air or the like in proper proportions is introduced through a suitable passage or passages at a velocity greater than the speed of ignition of the mixture, into a bed of refractory granular material of suitable texture in which it is burnt. Combustion of the mixture takes place in the bed around (on or in) the granules, thus maintaining the bed in a state of incandescence. This bed, part of which thus constitutes the seat of an intense combustion, may be disposed around, or in proximity to, the retort, muffle, chamber, or body to be heated, in such a manner as to produce the desired heat distribution. The bed of refractory material is enclosed or retained in position by an outer shell or walls of refractory material of low heat conductivity; the shell or walls being of sufficient thickness (or suitably lagged, or in some cases provided with stagnant air cavities) to give efficient heat insulation.

A feature of the invention is that it is well adapted for the combustion of a large variety of combustible gases—for example, blast-furnace gas, producer gas, water gas, coke-oven gas, coal gas, petrol air gas, and natural gas—although the temperature attainable in any particular case will naturally depend upon the calorific value of the gas employed. The invention lends itself to a variety of applications—for example, it may be employed in the construction of tube furnaces, muffle or retort furnaces, crucible furnaces, sagger furnaces, furnaces adapted to annealing operations, and for the heating of chambers and bodies in general.

In fig. 1 is shown a laboratory furnace for producing high temperatures. The furnace body is constructed of a sufficiently refractory material—such as fire-clay, calcined magnesite, or bauxite—and provided at the bottom with a hole to receive an iron pipe D for the supply of gaseous mixture. The end of the pipe terminates sufficiently far from the bed of granular material to prevent the pipe becoming unduly heated. On the branches of the pipe are two valves F for the regulation of the air and gas

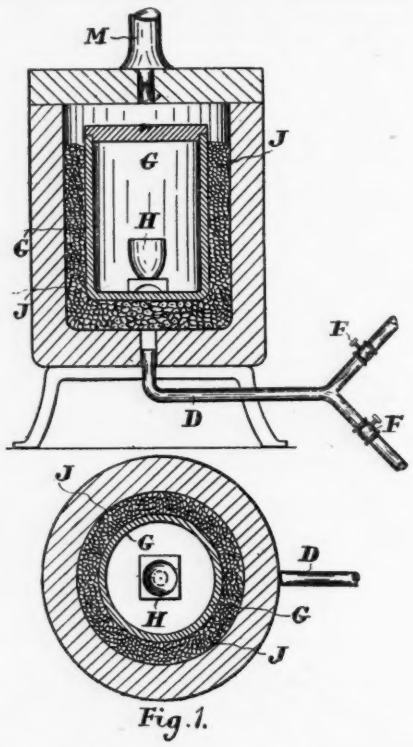


Fig. 1.

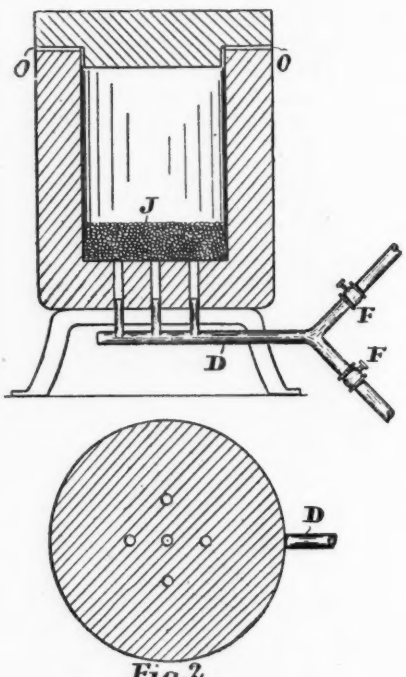


Fig. 2.

respectively. G is a cylinder of a very refractory material—such as bauxite—adapted to receive a crucible H or other article to be heated. J is the refractory granular material, which, provided the furnace body and vessel G are sufficiently free from ferric oxide and the like (as hereafter explained), may consist of carborundum crushed and meshed to such a size—for example, as will pass a sieve of two meshes to the linear inch, but will not pass a sieve of four meshes. A few larger fragments may be disposed in the neighbourhood of the hole below. The furnace is provided with a cover through a hole in which the products of combustion escape to a chimney M. The pressure of air and gas required will depend on the temperature desired and on the relative dimensions of the parts. In practice, when using coal gas it is convenient to employ a pressure of from 1 lb. to 2 lbs. per square inch.

Fig. 2 represents a similar construction of furnace adapted to the heating of crucibles, melting of metals, and other metallurgical operations. The furnace body is provided with a removable cover resting on projections O, between which the products of combustion escape. J is a bed of granular refractory material, to which the gaseous mixture is supplied through the holes connected with the pipes below, which themselves are connected with the gaseous mixture main D, to which gas and air are supplied and controlled by the valves F.

This description will suffice, it is said, to make clear the principle involved in the invention, and the way in which it may be generally applied in furnace construction. The patentees then indicate certain conditions which must be fulfilled in applying the invention in the above and other cases, as well as modifications of construction which may be found useful or desirable in special cases.

The granular material must be of a nature sufficiently refractory to stand the temperature produced by the combustion of the gaseous mixture, which, as stated, will depend largely on the nature of the gas employed. For example, where blast-furnace gas, producer gas, or other gas of low heating power is employed, a large variety of refractory materials may be used—for example,

calcined fire-clay, ganister, or the like. But where the highest temperatures are produced—as, for example, by the use of coal gas or oxy-hydrogen gas sufficiently diluted with nitrogen—special pains must be taken in providing a refractory material of a sufficiently refractory nature. For example, carborundum may be employed as the granular material, provided it is not in contact with any material or body containing ferric oxide or other oxide which at high temperatures will react chemically with the carborundum. Or very pure calcined magnesite may be employed, in which case the body or bodies in contact with the material must be of a basic nature. The size of granular material employed will be determined by the size of the chamber or body to be heated. Thus, for heating small crucibles or muffles, they have used granular material crushed to such a size as will pass a sieve of four meshes to the linear inch, but will not pass a sieve of eight meshes. On the other hand, in constructing a furnace for the heating of large saggers, they have used granular material the individual fragments of which are 1 or 2 inches in diameter.

It may be found advisable in certain cases, or for some purposes, to admit the air into the mass of granular or porous material in two or more portions, in order to allow the combustion of the inflammable gas or vapour to proceed in suitably regulated stages so as to produce a more regular or suitable distribution of the heat; or, conversely, the inflammable gas may be similarly introduced. Also, in the construction of large furnaces, or for the heating of long retorts or tubes, two or more beds of the granular material, each with its own separate supply of the mixture of combustible gas or vapour and air, and with or without separate exits for the combustible products, may be employed, or, in cases where the bed of granular material is extensive, two or more separate supplies of the combustible mixture of gas or vapour and air may be introduced at different points, or at different levels, so as to ensure a proper distribution of the heat.

In general, the method of starting-up a furnace and initially raising the bed of granular material to the state of incandescence required for the combustion of the gaseous fuel according to this invention will consist in first turning on the combustible gas and causing it to ignite by applying a flame to it as it issues from the bed of granular material. Immediately afterwards the supply of air is gradually turned on until the flame strikes-back, and combustion takes place in the granular bed—thereby raising it, or the lower layers of it, to the required state of incandescence. The proportions of gas and air are then adjusted so as to produce the desired conditions. In certain cases, where the furnace construction admits, a stoppered lighting hole or holes in proximity to the point or points where the gaseous mixture enters the bed may be provided.

It will be seen that the invention differs from their previous one in some important particulars. The object now being to produce high temperature in a confined space, combustion takes place in the mass of refractory material, which does not in this case serve to prevent firing-back. Hence the arrangement of a chamber of considerable size through which the combustible mixture passes on its way to combustion, must be replaced by a passage or passages of such length and sectional area in relation to the gaseous flow that firing-back is prevented. Owing to the conduction backward of the heat of combustion by the walls of the passage or passages, the narrowing of the passages must extend backwards to a point at which the temperature of the walls is lower than the temperature required to ignite the particular mixture used.

The essential features of the present forms of apparatus to obtain higher temperatures and concentrate the heat in a space which is more or less enclosed, may be enumerated as follows: (1) An outer shell or body composed of refractory material and being a bad conductor of heat. (2) An inner bed or layer composed of refractory material having interstices, into which bed the combustible mixture is introduced, and in which it burns. (3) An internal chamber in which the heat is required to be utilized, and which may or may not be surrounded by an internal shell of refractory material. (4) A passage (or passages) through which the combustible mixture passes, of such length and cross section in relation to the gaseous flow that the ignition of the combustible mixture shall not travel backwards in the passage.

Scottish Junior Gas Association (Eastern District).—We learn from the Hon. Secretary (Mr. W. Geddes, of Granton) that the second visit of the members of the Eastern District Division of the Scottish Junior Gas Association will take place next Saturday afternoon, when they will be afforded an opportunity of inspecting the fire-brick works of Messrs. James Dougall and Sons at Bonnybridge. At the conclusion of the visit, Mr. E. M. Stewart will read a paper on "Fire-Bricks."

Entertainment to Stafford Corporation Employees.—Last Tuesday, Mr. Hubert Pooley, who will shortly be leaving Stafford to take up his new duties at Leicester, entertained the members of the staff and employees at dinner at the Swan Hotel. There were upwards of a hundred present; among the company being the Chairman of the Gas Committee (Alderman C. H. Wright). Mr. W. M. Valon, Mr. Pooley's successor, was unable to attend. The toast of the evening, "The Health of Mr. Pooley," was proposed by Mr. S. Caulfield, who took an opportunity of sincerely thanking the host for his generous hospitality. He said Mr. Pooley had been at Stafford ten years, during which time he had enjoyed the esteem of everyone who knew him. A programme of music was an enjoyable feature of a very pleasant evening.

GAS AND ELECTRICITY FOR STREET LIGHTING.

A Comparison of Costs and Effects.

At the last Meeting of the Institution of Electrical Engineers, a paper, on "Street Lighting by Modern Electric Lamps," was read by Mr. HAYDN T. HARRISON, in which he made some interesting comparisons of the cost of gas and electric lighting. The following are extracts from the paper.

In the very early days of electric lighting, the streets which, owing to their importance, required increased illumination, were changed from gas to high candle-power lamps, such as arc lamps. But, unfortunately for electrical engineers, these streets were comparatively few in number compared to the thousands of miles of less important streets and roads which were, and are, lighted by incandescent gas-lamps. Moreover, the high candle-power arc lamps which electrical engineers had at their disposal for competitive purposes, gave their maximum candle power at an angle requiring that they should be placed at a considerable height and at a short distance apart when required to obtain an even illumination, which resulted in a high cost per mile of lighting. The improvements connected with electric lamps which have taken place within the last two years have placed electrical engineers in a very different position, not only as regards large units of light—arc lamps being now available which give their maximum candle power in the direction most suitable for street lighting—but also with small units; incandescent lamps, such as tungsten lamps, being available, which give four times the candle power of the carbon lamps for the same consumption of energy. It was the advent of these efficient small units of light that gave electrical engineers an opportunity of competing favourably with gas for side-street lighting, as they can be installed without a heavy outlay in capital; and as most of the streets are sufficiently well illuminated by small light units, a large and valuable load results.

In nearly every town and city of this country, gas, being the illuminant available at the time when the streets were built, was naturally chosen for the purpose; and electrical engineers have found that, in order to displace it, they must be in a position to supply lamps of about the same candle power either at an equal or a lower cost, as it is often not considered advisable to go to the expense of "scrapping" existing posts and lanterns. I propose, therefore, to lay before you the figures relating to the Borough of Marylebone, where the incandescent gas-lamps have lately been replaced by electric (tungsten) lamps. In this case, the procedure was as follows: The Electricity Supply Department of the Council were advised by their Consulting Engineer to ascertain exactly the illumination given by the existing gas-lamps; and an outside testing authority intimately connected with the gas industry was instructed to test at random 100 street gas-lamps in the district. The results showed an average for the single 4½ cubic feet gas-mantles of 50-candle power and 76·6-candle power for the double mantles. Mr. Arthur Wright having discussed the matter with me, I tested for my own satisfaction and found that with the single mantles I obtained an average of 45-candle power, and with the double 76-candle power. It was decided that the single lamps should be replaced by two 115-volt 35-watt Osram lamps in series, and the double lamps by two 55-watt lamps. It was estimated that the capital cost of converting 1964 lanterns and connecting them to existing distributors would be £8000. But, owing to the excellent systems adopted by the Mains Engineer of the Council and his assistants, the work has been done for £5788, or an average of less than £3 per post; and when it is borne in mind that the work was carried through in three months, at an average of nearly 200 posts a week, without in any way interfering with the continuity of supply to a single customer, great credit is due to the organization of the department.

The excellent results obtained have led to the Council deciding to convert the remaining 1385 lanterns in the district; but owing to these not being adjacent to existing distributors, new ducts and mains were necessary. As these would, of course, eventually have to be laid for private lighting and power supply, it is difficult to allot the right amount of capital charges to the public lighting. But even if the whole of it were allotted to public lighting based on a 25-year loan, and the cost of the electric fittings be repaid in three years, £1640 would still be available for electric supply if the existing gas-rate were still charged for lighting. This is equivalent to 0·9d. per unit for the first three years, and 1·17d. per unit thereafter. The 1964 lamps when lighted by gas cost the Council for gas, lighting, extinguishing, cleaning, and maintenance, £8818 per annum. The gas contractors, when asked for a revised tender, reduced their price considerably, but were unable to compete with the tenders of the Electricity Department, which amounted to £7350 per annum, made up as follows:—

			Per Post.
A.—Electrical energy at 1·42d. per unit .	£3950	=	£2 0 0
B.—Lighting, extinguishing, cleaning, painting, &c.	1570	=	0 16 0
C.—Lamp renewals.	1230	=	0 12 6
D.—Repayment of cost of electric fittings in three years	600	=	0 6 6
Total	£7350	=	£3 15 0

It must be remembered that 1964 street lanterns included in this charge contain lamps of various candle power. In dividing

them, the proportionate cost of each per annum would be approximately as follows, taking energy at 1·42d. per unit :—

	70-Watt.	110-Watt.	160-Watt.
A . . .	28s. 6d.	45s. od.	64s. od.
B . . .	16 0	16 0	16 0
C . . .	12 0	12 0	15 0
D . . .	6 6	6 6	6 6
Total .	63s. od.	79s. 6d.	101s. 6d.

The figure charged (1·42d.) was not arrived at with any idea of the cost to the Electricity Department, but in order to repay the cost of the services at an early date. If the charge per unit had been 1d., which is more consistent with the costs of generating, the sum of £3950 per annum would be reduced to £2780, which allows £1170 per annum for repayment of cost of services, &c., the cost of the repayment of the electric fittings being already allowed. This will easily wipe off the cost of the services in five years. Therefore, if a ten-year or a fifteen-year loan had been arranged, the price could have been reduced to 1d. per unit, which would work out as follows :—

	70-Watt.	110-Watt.	170-Watt.
A.—Electrical energy at 1d. per unit.	24s. od.	38s. od.	56s. 6d.
B, C, and D, as before .	34 6	34 6	37 6
Total	58s. 6d.	72s. 6d.	94s. od.

Note.—Charges B and C have since been reduced; thus an actual higher rate is being obtained for current.

The illumination of the streets of Marylebone has been improved by the conversion. The tests on the gas-lamps mentioned previously are compared with tests on the electric lamps. In total candle power, these figures are very striking: The 1964 gas-lamps gave a total of 109,000-candle power; and 1964 electric lamps give a total of 146,000-candle power at 20° and 193,883-candle power at 10°. As regards the illumination, this was, of course, increased directly in proportion to the increase of candle power as the position, height, &c., of the lamps remained the same.

The number of posts to the mile varies with the importance of the thoroughfare or street, and also the width of the roadway. The above results take these two factors into consideration, and are calculated from actual candle-power measurements in the street. In the important thoroughfares, there are an average of 76 posts to the mile, and in the less important streets 65 posts; so that at 1·42d. per unit the cost per annum works out at: Main thoroughfares, £384 per mile; side streets, £204 per mile. Or if electrical energy be taken at 1d. per unit, the cost would be £356 and £190 per mile respectively.

Before leaving the subject of the Marylebone lighting, it is necessary to consider a third type of thoroughfare—viz., Oxford Street. At the time Oxford Street was changed from gas to electricity, the most efficient lamp available for the purpose was the converging carbon flame arc lamp. This was therefore used; the globes being of the opalescent type recommended by the makers. Where favourable, two such lamps were erected on centre poles at distances of nearly 200 feet. This resulted in a minimum horizontal illumination of 0·11 candle-foot. Thus it will be seen that the cost of this type of lamp works out at nearly £20 per annum. The results are roughly as follows: Minimum horizontal illumination, 0·11 candle-foot; cost per annum per mile, £800.

Since that time, the arc-lamp makers have turned their attention to altering the distribution of light from flame lamps in order to make them more suitable for street lighting. For instance, in the case of arc lighting, it is difficult to arrange for the arcs, when erected on posts, to be higher than 25 feet from the ground; and the distance between them is rarely less than 150 feet, and is sometimes as much as 300 feet. Therefore the light rays which reach the point of minimum illumination are those which emanate at 10° to 17° from the horizontal. Some tests which I have lately conducted in Oxford Street, Oxford Circus, and Regent Street proved these rays to be of the following candle power: 10-ampere Union flame arc lamp, opalescent globe, 10° to 15°, 1100 to 1200; 10-ampere Union flame arc lamp, dioptric and opalescent globe, 10° to 15°, 1750 to 1800; 12-ampere Union flame arc lamp, dioptric and clear globe, 10° to 15°, 3700 to 4400.

While discussing highly illuminated streets and the use of high candle-power units of light, the relative results obtained by the use of high-pressure gas-lamps is of interest. Therefore I will refer to the tests made by Mr. J. T. Morris at the East London College,* from which he draws the conclusion that the candle power of a high-pressure gas-lamp varies 50 per cent., depending on the quality and pressure of the gas. His figures show that from 30 to 34 candles per cubic foot of gas consumed per hour is a very average result, when working at a pressure of 4 inches of mercury. As my own tests tend to corroborate this, I will take as an example a nominal 1500-candle Keith lamp, which gave on test between 720 and 780 candle power with a consumption of 23 cubic feet per hour. This, when compared with a flame arc lamp giving 5-candle power per watt at 1d. per unit, would have to be supplied with gas at 7d. per 1000 cubic feet in order to produce the same light for an equal cost; and thus it is obvious that even high-pressure gas-lamps do not compare favourably in cost with those high candle-power electric arc lamps which embody the improvements of the last few years.

Among other examples of the great improvement possible with modern electric lamps, I would like to mention Harrogate, where the Engineer (Mr. Wilkinson) has replaced the arc lamps by four 100-candle power tungsten lamps, arranged on spreading arms at a considerable height; the result being excellent both as regards illumination and appearance. It is interesting to note that at Harrogate the lamps are used without globes, but are provided with prismatic reflectors. This leads up to the question of reflectors generally. It is important that the reflectors should be designed with the object of reducing the effect of "glare"—in other words, of counteracting the high intrinsic brilliancy of the light source. With arc lamps, opalescent globes are very generally used to get over the effect of glare; but the greatest care is necessary in selecting these, as the loss of light is very often a serious matter.

Some very interesting work has lately been carried out in the City of Westminster in connection with street lighting by gas; and as at the time of writing the lighting of Victoria Street has been completed, the writer has had an opportunity of measuring the illumination and judging the effect of what may be taken as the most modern form of gas lighting. It is not proposed to enter upon any criticism of the Local Authority's action in accepting the tender of the Gas Company, but only to compare the results now obtained with those which existed in the past, and those which could have been obtained by other units of light which were tendered for by the Gas Company. Before going into these figures, it is necessary to examine that part of the specification relating to candle power under which the Electric Light and Gas Companies tendered. This is somewhat unique, reading as follows: "The candle power shall be arrived at by taking the average of two sets of readings in any position with regard to the light under test—one set at an angle of 20°, and a second set at an angle of 50° to the horizontal." It will be noted that there is no statement that the 20° ray shall bear any definite ratio to the 50° ray. Mr. Jacques Abady, referring to this in his paper on the subject read before the Institution of Gas Engineers, said: "Of course, it might be possible for an enterprising individual to make a lamp giving 180 candles at 50° and none elsewhere; and this would be a 90-candle lamp. But a lamp such as this would not comply with the general specification of the Westminster testing clause; and the example is cited simply as a *reductio ad absurdum*." Be this as it may, surely a clause stating what ratio the one ray should bear to the other was necessary, as any individual might have taken advantage of this clause, and tendered for converging flame arc lamps with clear glass globes, or direct-current open-type arc lamps, which at 50° give from three to five times more candle power than is obtained at 20°. The use of such lamps as these would naturally have resulted in a very low minimum illumination. As it is, the high-pressure gas-lamps installed give about 1·5 times more candle power on the 20° ray than on the 50° ray. This is, of course, a ratio in the right direction, but not sufficiently so to prevent the illumination adjacent to the post being 20 times that of the minimum illumination, whereas with the small gas units displaced it was only 16 times as great; and if the height of the small units had been that of the present units, it would only have been twice as great, which would have come under the head of even illumination.

The units of light according to the specification were to be 90, 180, 300, 1800, and 3000 candle power, for which the accepted Gas Company's tender works out at £2 16s. 6d., £4 10s., £6 10s., £15 10s., and £22 per annum respectively. Of these, the 1800-candle unit fixed 20 feet high was selected for Victoria Street. This street is approximately 3600 feet long, and 25 such units have been erected in place of 50 upright double incandescent gas-mantles placed 12 feet from the ground, with the result that the minimum illumination is increased to 0·15-candle power.

The author next passed on to deal with the cost of public lighting by electricity, which he said depends on three factors: (1) Cost of electrical energy; (2) cost of lamp maintenance; and (3) capital charges and their repayment. Considering the first item from a consumer's point of view, he adopted the standing charges per kilowatt of demand given by Messrs. Handcock and Dykes in their paper read before the Institution in November last year —viz., £17. This for a 60-watt lamp would work out at 20s. per lamp per annum. Taking the running charges at 0·4d., and the hours of burning at 4000 per annum, he arrived at 96d.; making a total charge of 28s. per lamp per annum, or at the rate of 1·4d. per unit. Treating the street-lamps as an ordinary customer, he thought a remunerative price would be 1d. per unit for large undertakings and 1·5d. for small ones, inclusive, as in the case of consumers, of the cost of service to the ordinary distributors, but not of fittings, &c., which would come under the same heading as the consumers' wiring and fittings, which are part of the installation. With regard to lamp renewals, taking total candle-power units from 50 up to 500, the cost with tungsten lamps would range from 2·4d. down to 1·2d. per candle power per annum, with naked lights, and from 1s. 3d. down to 0·6d. in special lanterns. Lighting and extinguishing would range from 4d. down to 0·4d. per candle power; and the cost of carbons, &c., taking the units at from 300 up to 4000 candle power, from 3·6d. down to 0·15d. Adding together all the figures arrived at, the author gave the following table showing the cost per candle power per annum,

* A lecture by Mr. Morris, on "Daylight Illumination," was noticed in the "JOURNAL" for the 21st of June last (p. 864).

exclusive of capital charges, and taking 1d. per unit as the price of current in pence:—

	Candle Power of Light Unit.	Total Cost per Candle Power per Annum with Naked Lamp.	Cost per Candle Power per Annum in Special Lantern.
A.	50 tungsten	10·50	7·0
	100 ,,	8·20	5·0
	200 ,,	7·00	4·3
	300 ,,	6·66	4·1
	400 ,,	6·50	3·8
	500 ,,	6·40	3·5
B.—300 open arc		10·20	—
C.	1000 flame arc	3·65	—
	3000 flame arc (dioptric and clear outer)	1·32	—
D.—2000 to 4000 regenerative flame		1·0 to 0·8	—

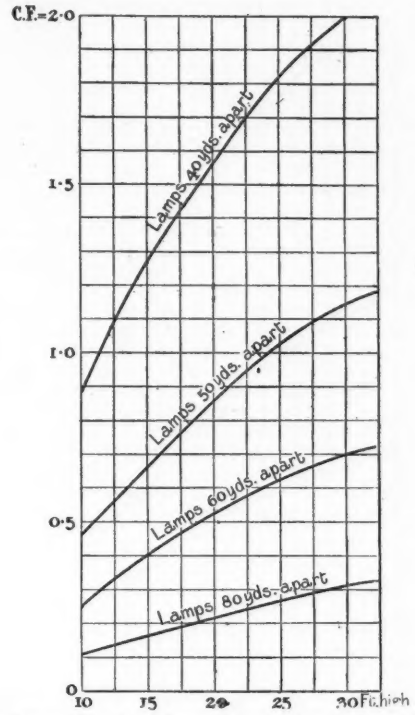
Having obtained an approximate table of costs per candle power per annum for various units of light, the author said it would be easy to ascertain which were the best to use under different circumstances. In order to assist in coming to a decision, he gave the following table showing the total candle power needful to produce a minimum of horizontal illumination of 0·1 candle-foot with lamps spaced at various distances and at heights of 20 feet and 12 feet respectively.

Space between Lamps.	Candle Power of Lamps.		Total Candle Power per Mile.	
	12 Feet High.	20 Feet High.	12 Feet High.	20 Feet High.
Yards.				
100	..	8800	..	156,000
90	..	6300	..	125,000
80	7300	4539	160,000	100,000
70	4800	3060	121,000	76,600
60	3140	1950	92,000	57,000
50	1820	1186	63,500	41,600
40	950	620	41,500	27,300
30	400	300	23,300	17,600

The author directed attention to two important factors which he said were noticeable in the above table—viz., the large reduction in the total candle power necessary to produce the same minimum degree of illumination with small units of light placed close together, and the effect of the height of the lamps on horizontal illumination. He pointed out that when lamps are spaced at 30 yards, only one-ninth of the total candle power gives the same result as when they are placed 100 yards apart. Therefore, from the table of costs per candle power, it would be seen that unless a lamp giving a very high candle power at low cost were used, the closer spacing would be the cheaper alternative. Converging flame lamps (unless provided with dioptric globes), when erected at 70 yards, would give illumination, at the same cost, equal to small units of light placed between 40 and 50 yards apart, provided, of course, the small units of light were fixed at the same height.

Referring to the height of lamps, the author said: Based on horizontal illumination, and obviously in order to obtain even illumination, they should be placed as high as possible. For instance, if the lamps in Baker Street had been 20 feet high, the minimum horizontal illumination on the ground would have been 0·11 instead of 0·08-candle power, or an increase of nearly 50 per cent. But I doubt whether the Lighting Committee or the public would agree that the illumination of the street had been improved 50 per cent., and I am certain that there would be no hesitation in their choice between increasing the height of the lamps 8 feet or the candle power 50 per cent., provided the increased candle power cost no more. This, to my mind, demonstrates clearly one of the objections to horizontal illumination as the gauge of street lighting, for the increase in the height of the lamps would not in any way increase the illumination of pedestrians and vehicles or other vertical objects; and it is certainly misleading owing to the introduction of the cosine factor. [See diagram.] On the other hand, the specifying of minimum horizontal illumination does encourage raising the height of the lamps; but, as I have mentioned in previous writings, the factor of direct illumination covers this point when the maximum and minimum are stated. That the difference between the maximum and minimum illumination at any point of a street should be as small as possible is so important that it is gratifying to note the comparatively low candle power when measured near the vertical of the tungsten and modern arc lamps, especially when the former are in correctly designed lanterns. For example, maximum illumination with the inclined carbon flame lamps is as high as 10 candle-feet in Oxford Street, with a minimum of 0·11 candle-foot, or a diversity factor of 90. In Baker Street, the maximum illumination on the ground is 0·5 candle-foot with a minimum of 0·08 candle-foot—a diversity factor of only 6. Again, in Regent Street, where "Excello" lamps having dioptric globes are in use, the maximum illumination does not exceed 3 candle-feet; the minimum being 0·23 candle-foot, or a diversity factor of 13.

The importance of correct characteristic light distribution is clearly brought out in the following curve, where the candle power at various downward angles necessary to produce even illumination is compared with that given at those angles by tungsten lamps with a suitable reflector, such as the Marylebone type, which it will be noticed closely approaches the correct curve, a vertical low-pressure gas-mantle which gives about the same curve as a tungsten lamp without a reflector, and a low-pressure inverted gas-mantle.



CURVE showing variation in horizontal illumination due to various heights of lamps. This curve is calculated on the basis that the lamps are giving equal candle-power at all hemispherical angles. It demonstrates clearly the effect of the cosine factor if horizontal illumination is used for comparison purposes.

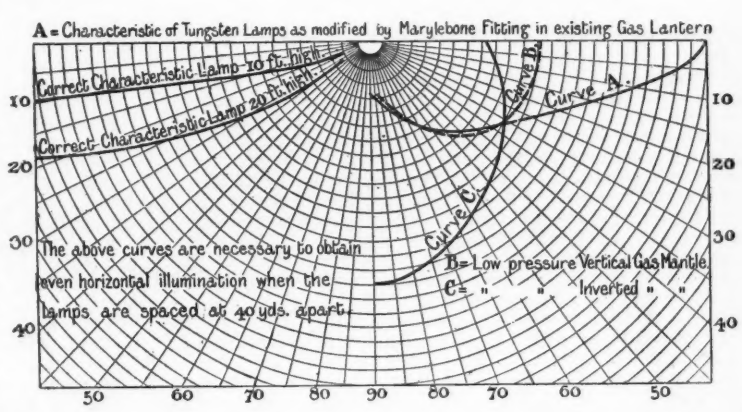
The effect of using correctly distributed light is not only more even illumination, but also reduced cost of lighting for a given minimum, as shown by the following comparisons:—

Position.	Minimum Illumination.	Diversity Factor.	Cost per Mile per Annum.
Baker Street (electric)	0·08	6	£356
Regent Street (electric)	0·23	13	660
Victoria Street (high-pressure gas)	0·15	20	540

NOTE.—The tender for the Regent Street type of lighting was subsequently reduced to £425 per mile per annum.

The above figures direct attention to the considerable variation in the diversity factor of illumination. The importance of this factor cannot be overrated. Mr. A. J. Sweet, in his paper read before the Franklin Institute of Philadelphia,* states that a ratio of maximum to minimum (illumination) of 4 to 1 is permissible; and he points out that the present factor more frequently falls between 100 to 1, or even 500 to 1. For example, in Oxford Street, using flame arc lamps, it is 99 to 1; whereas in Regent Street, where the same type of lamp was employed, but with a dioptric globe, this was reduced to 13 to 1. In Victoria Street—the latest example of gas lighting—it is 20 to 1; whereas in the important streets of Marylebone it is 6 to 1. In both Regent Street and Marylebone, this great advance was brought about by the correct use of globes and reflectors specially designed for the purpose. It is the possibility of one using such globes and reflectors with

* See "JOURNAL," Vol. CX., pp. 437, 502.



electric lamps which gives them great advantage over gas, where the dissipation of the great heat necessary for the efficient use of mantles makes the employment of efficient globes and reflectors a practical impossibility. For instance, in Victoria Street the light rays from the high-pressure gas-lamps which reach the point of minimum illumination are only 1·5 times the power of those adjacent to the lamp-post. In the case of the tungsten lamps in Marylebone, they are six times the power; hence the more even illumination. It is interesting to note that if the latter lamps had been placed a few feet higher, and spaced at (say) 100 posts to the mile, the illumination would have been even throughout the street, with a diversity factor of unity. At first sight, this would appear to increase the cost considerably; but this is not so, as the candle power of the lamps could be reduced to one-fifth without reducing the illumination.

I must apologize if I have too often repeated examples and figures proving that the multiplicity of small light units results is more efficient street lighting. But the fact that measurements and figures invariably lead to this conclusion proves that it is well worthy of the consideration of those who have to deal with street-lighting problems. I am aware that the average man who is asked to compare brilliant and powerful lamps with the less brilliant but increased number of light sources will generally vote in favour of the powerful light, regardless of the result; but the fact that the Marylebone lighting has given satisfaction to all concerned does prove that in the long run even illumination is appreciated.

The eyesight of the present generation is suffering from the indiscriminate use of large glaring light units unsuitably placed. Therefore it is important that those who are called upon to illuminate streets, where the minimum illumination cannot exceed 0·1 of a candle-foot, should not be tempted to accentuate this low figure by producing a few patches of bright light. It is noticeable that in the past the small light units derived from gas have been more economical for outdoor lighting than those produced by electricity. The reverse is now the case. Therefore electrical engineers should be able to compete favourably, considering that the light they are able to supply is constant, reliable, capable of correct distribution, and easily manipulated, which must result in its adoption for exterior lighting in the same way as it has been so generally adopted for interior lighting.

There is one other feature which I should like to take this opportunity of bringing to your notice—viz., the rating of light units. It is the custom to mark incandescent electric lamps with the mean horizontal candle power; and they are known by this figure. But if by the use of suitable reflectors or globes it is often more than doubled over the angles where the light is required, that unit becomes of twice the value. In completing this paper, difficulty of this sort has arisen; and when calculating the cost per candle power the writer has in most cases given figures based upon the horizontal candle power of the naked tungsten lamp, whereas (where they have been erected in suitable lanterns or globes) this cost per candle power-hour is reduced to one-half or one-third. This must be carefully borne in mind when using the tables referred to.

In conclusion, the author said he should like to take the opportunity of warning engineers that good illumination, though the prime object in street lighting, is not the only feature to be considered. Careful thought must be given to obtaining as even illumination as possible; and if high intrinsic brilliancy were avoided, the result would be in every way satisfactory, not only to the lighting authorities, but also to the general public.

Discussion.

Mr. Frank Bailey said it was the duty of all lighting companies and authorities to call the attention of municipalities to the meagreness and the very unsatisfactory nature of most of our public lighting. At present they seemed satisfied to have very little more than was the case many years ago, when the conditions of street traffic were entirely different from what they are to-day. The difficulty was that those in charge of this sort of work knew very little about it. An electrical engineer could do very much more for street lighting if he were only allowed to try. This had been his position in the City of London during recent years; for he had had to beg to be allowed to demonstrate what his Company [the City of London Electric Lighting Company] could do with modern appliances. In his opinion, the standard of illumination should not be less than that given by the new electric arc lamps suspended across the roadway in Cheapside. It should be possible in every thoroughfare to be able to see from end to end. He did not think the author's price of 1d. per unit for street lighting was one that could be quarrelled with. Certainly it was one with which it was worth while to push the use of metallic filament lamps in streets of minor importance. In main thoroughfares, however, the lighting could only be carried out properly by means of flame arc lamps of large candle power placed high up. He put Cheapside forward as an example of what should be done in main thoroughfares; and there were plenty of them in London which justified an expenditure of £800 per mile, which was not an excessive sum for what was absolutely required for the protection of life and property.

Mr. C. P. Sparks said the electrical industry was, comparatively speaking, new in the public lighting business; and he thought the Institution of Electrical Engineers could do a great deal of good by appointing a Committee to draw up a standard specification for street lighting which, while it might not be adopted in all cases, could be taken as a guide, and serve as an authoritative basis. The industry had been very much handicapped hitherto by the fact that there had been only large units of light; but the advent of the metal filament lamp had proved a great advantage. Until recently, all the pioneer street lighting had been in the hands of the gas companies; but (to a large extent due to Mr. Harrison, who had devoted himself specially to the question of street lighting in recent years) a change was coming over the scene. In looking at what had been done in the past in public electric lighting—and it was mostly in those places where the municipality owned the electricity works—one could not help noticing the poor comparison between the old open type of arc lamp which still very often existed, and modern gas lighting; and at the rates at which many of the old contracts had been taken, there was ample margin to allow of discarding the old fittings and putting in modern flame arc lamps. With regard to Mr. Harrison's figure of 1d. per unit, in view of the prices now being quoted by the gas companies, he regarded this as on the high side; and he felt quite sure that unless electricity supply undertakings were prepared to offer energy at a lower rate than was indicated in the paper, there was not much chance of the electrical industry wresting the bulk of the public lighting from the gas companies.

Mr. A. H. Seabrook referred to the statement in the early part of the paper that, as the results of tests in Marylebone, the average for the single 4½ cubic feet gas-mantles was 45 to 50 candle power, and about 76-candle power for the double ones. If they compared these figures, taken from mantles in actual commercial use, with those given as the correct ones by the gas companies, the result would be very striking. If a few more people would do this, there would not be the absurd disbelief in electricity for lighting, heating, and cooking that existed at the present time. He disagreed with Mr. Sparks as to 1d. per unit being on the high side. In Marylebone, the Council were at this price saving £3000 per annum compared with the old gas figures; and it seemed ridiculous to go below it. They had to fix their price according to what the light would fetch, and also bearing in mind the prices charged by their competitors; and a saving to the extent he had mentioned seemed good enough to give to the rates. Dioptric globes appeared to him to cause a considerable and unpleasant glare, an example of which was to be seen in Regent Street. He would have liked more information about side-walk lamp-columns, as compared with centre lamps for arc lighting. He had come to the conclusion that where a street was wide enough for centre columns, this was the best position in which to put the arc lamps, or any others of high candle power. Arc lamps on the footpaths wasted an enormous amount of light on the buildings, which did not require it; and if a street could be lighted by centrally-supported lamps, it seemed to him to be the best way out of the difficulty.

Mr. W. A. Vignoles thought it was questionable whether Mr. Harrison's view that the minimum horizontal was the best standard of illumination. In walking between two lamps, they did not want to look at anything in the horizontal so much as in the vertical direction. When the change from gas to electricity was made in Grimsby, it was a question whether they should retain the existing posts. It was finally decided not to take them over, for the reason that it meant fixing fuses either at the top of the posts or else digging a pit in the ground in which to place them. They therefore purchased new posts, and put in a new fitting. At the same time, from the point of view of getting a brilliant effect in a street, there was nothing better than a gas-lantern. They could design scientific fittings to take their electric lamps; but, when all was said and done, an electric lamp hung inside a gas-lantern, with four panes of glass round it and a white reflector at the top, was very hard to beat.

Mr. L. Gaster, referring to the subject of a standard specification for street lighting, said that about a year ago the Verband Deutscher Elektrotechniker appointed a Committee to draw up a specification for indoor and for outdoor lighting. This was to include illumination at certain heights, the mean and maximum illumination for the various classes of streets, and so on. His point was that, until they settled what was wanted, they could do nothing. At present, when people wished to know anything about street lighting, they had to go to the Continent. He had heard it stated that London seemed to be the laboratory of the world in public lighting; and this was brought about because every borough engineer desired to do something better than his neighbour. A committee having upon it representatives of all those interested in street lighting was certainly badly wanted in this country.

Mr. C. M. Shaw differed from Mr. Vignoles as to the advisability of using the existing gas-lanterns when introducing electric lighting. He also thought that lower prices than those now charged for electric lighting in streets would have to be introduced if they were to make any progress in getting gas out. The author had mentioned £204 per mile for lighting side streets; but he (Mr. Shaw) only got £120 in Worcester, and was satisfied.

Professor J. T. Morris suggested that an improvement in street lighting would be effected if the lamps were screened down to from 10° to 15° below the horizontal. He thought it was an open question as to whether the sources of light in a street should be actually visible.

Mr. K. Edgcumbe thought it would be doubtful whether the Institution of Electrical Engineers could appoint a Committee to draw up a standard specification without inviting representatives of the gas engineers and also architects.

Mr. H. Boot said he had made some tests which showed that street lighting could be undertaken at very little more than ½d. per unit.

Mr. Harrison, in reply, said he was not at all in favour of centre lighting, because, while it was good for the pavements, it was not good for the drivers of vehicles, who were mounted rather high, and who must, at some moments, have the lights in their line of vision. The question of a standard specification was a difficult one, because the gas people could not be ignored altogether; and it was doubtful whether any specification would be generally adopted unless it was mutually agreed upon. Probably some independent institution, like the Institution of Civil Engineers, would have to take the matter in hand. It would have to be a society to which surveyors belonged, as they were the gentlemen who had the street lighting under their control. Unfortunately, very few surveyors had made a study of illumination. He agreed that his price for electrical energy was high; but electrical engineers did not seem disposed to do what the gas companies did—viz., do the thing cheaply for the sake of the advertisement. Municipal electrical engineers would be told that they were giving the current away if they did this.

THE PRESENT STATUS OF GAS LIGHTING.

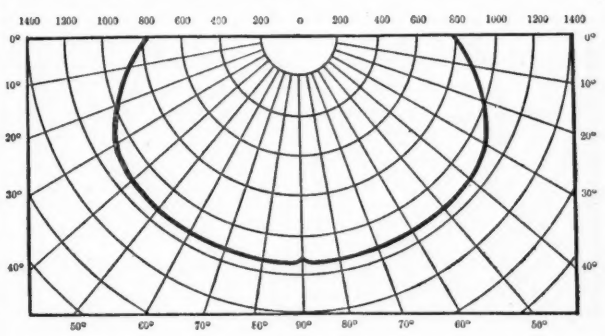
Some Expert Experiences.

On the occasion that Mr. F. W. Goodenough read before the Illuminating Engineering Society, his paper on "Recent Progress in, and the Present Status of, Gas Lighting" (*ante*, p. 468), it was announced that some contributions had been received from correspondents, and would be published in the official journal of the Society. This has now been done; and from the communications the following extracts are made—these being of interest on account of the testimony afforded, from such widely separated quarters as London, Paris, and Berlin, as to the marked progress in efficiency that has been scored by inverted incandescent gas-lamps, both high and low pressure.

M. Lauriol (Chief Engineer of the Lighting Department of the City of Paris), in the course of his communication, remarks that, when comparing ordinary upright incandescent burners, it is only necessary to measure the horizontal intensity, as the form of the intensity curve will be the same for different burners; but a measurement in one direction only is not sufficient, as the value in different directions may vary as much as 10 per cent. from the average value. Measurement in four directions at right angles is suggested as satisfactory. A comparison of upright and inverted burners for street lighting should be on the basis of the mean lower hemispherical intensity. In the case of interior lighting, the question as to the best basis of comparison is more difficult to settle. In some cases the hemispherical, and in others the spherical, intensity would be the most satisfactory, according to the quantity of light that may be reflected from the ceiling and walls. In general, the mean spherical intensity is to be preferred. The following figures give the results of some recent tests on efficiency attainable with Paris gas (tested according to the method of Dumas and Regnault for the candle power of flame-burners), and also tested in the laboratory for calorific power, giving practically 4800 calories per cubic metre (steam not condensed). The figures are given in international candles, and are the average values for 400 hours' working; the efficiency being actually about 10 per cent. lower at the end of 400 hours. Ordinary burners, with ordinary pressure of 50 mm. (2 inches) of water: Small burner (mean horizontal intensity), consuming 50 litres (1¾ cubic feet) per hour, 1·25 litres per candle-hour (23 candles per cubic foot). Medium burner (mean horizontal intensity) consuming 80 litres (2·8 cubic feet) per hour, 0·95 litre per candle-hour (30 candles per cubic foot). Large burner (mean horizontal intensity) consuming 150 litres (5¼ cubic feet) per hour, 1·30 litres per candle-hour (22 candles per cubic foot). Thus the medium burner gives the highest efficiency. Inverted gas-burners (mean hemispherical intensity): Pressure, 50 mm. (2 inches); burner of 80 litres (2·8 cubic feet) per hour; consumption, 1·38 litres per candle-hour (21 candles per cubic foot). Pressure, 1400 mm. (55 inches); burner of 300-2500 litres per hour (10½-87 cubic feet); consumption, 0·67 litre per candle-hour (43 candles per cubic foot). Dealing with other points, he says that, with ordinary pressure (50 mm. or 2 inches) good mantles last 400 hours, with a decrease of 20 per cent. from the initial efficiency. This applies only to laboratory experience. The intrinsic brilliancy of any lamp is too high for direct light to be allowed to enter the eye direct; and screening, either with diffusing globes or else with thick opaque paper or thin metal shades, is desirable in the case of indoor lighting. For street lighting, diffusing globes are at present used with electric arcs, but not for gas-lamps, however powerful they may be. But it is not certain what the future practice in this respect may be. In the case of an incandescent burner, the higher the pressure at the nozzle of the burner, the higher the efficiency, provided that the burner has been designed for this pressure. In practice, it is therefore desirable to maintain the pressure at the burner constant, and keep this pressure as near as possible to the high limit. Now, a gas-governor cannot raise the pressure above the value of the supply; it can only reduce the pressure in the burner to a certain limit, p, for which the burner is designed. Consequently, when the pressure in the pipes is less than p, the governor cannot achieve its purpose. Therefore it is desirable to maintain in the pipes a somewhat higher pressure than this value p, and also to design both governor and burners for use on the highest pressure that can actually be attained in the pipes during lighting hours. In Paris, the contract entered into with the Gas Company specifies that the pressure at any point in the street network must not be less than 40 mm. (1·6 inches) of water. In practice, it is always maintained at a somewhat higher value; and the burners and governors in use are designed for a pressure of 50 mm. (2 inches).

Mr. George Keith (London) points out that it is naturally not possible to give the maximum efficiency in candle power per cubic foot of gas consumed per hour, unless it is known what kind of gas is to be used, as the results vary considerably according to the quality. In my experience, however, he continues, one can obtain on the average 60 candles per cubic foot; and in some cases, where extra good coal gas is obtainable, we have obtained results as high as 73 candles per cubic foot. As an illustration of the dependence of the results on the quality of gas, it may be said that, using our system with oil gas, and that only in small units, we have obtained as high a result as 120 candles per cubic foot of gas consumed. The pressure we employ is ordinarily 54 inches of water (or 2 lbs. per square inch); but we occasionally go higher than this if necessary. In my opinion, the most accurate method of expressing the lighting value of a lamp is unquestionably in terms of the mean lower hemispherical value. It is not necessary or desirable to use a diffusing globe with lamps for outside lighting, as the light is already very well diffused, and is not sufficiently concentrated to cause discomfort or injury to eyesight. For inside lighting, in cases in which small units are used close to the eye, it is often found desirable to shield the eye from the direct light of a mantle by opal or frosted glass.

Professor H. Strache (Vienna) says the maximum efficiency which was attained in tests undertaken last year in the Testing Institution for Gas Lighting of the Vienna Technische Hochschule, was stated to be 0·697 litre per Hefner candle sub-hemispherical (37·0 Int. candles per cubic foot), with a gas pressure of 50 mm. (at 0° C. and 700 mm. barometric pressure). The gas was 4880 Cal. per cubic metre. In this Institution, the mean hemispherical efficiency of the source of light (unless any other particular method is specially desired) is determined as follows: The burner is rotated around its vertical axes, and readings are taken in eight different positions. Subsequently, readings at intervals of 10 degrees in a vertical flame are taken, and the polar curve is obtained. Then the calculation is made by the aid of the Rousseau curve in the usual way. The renewal of the mantles intended for outdoor lighting should be effected when their efficiency has diminished by 20 per cent. In our most important gas-works the adjustment and cleaning of globes, as well as the replacement of mantles, is not carried out by the gas company itself, but especially by sellers of mantles. Small gas-works sometimes undertake this maintenance for some fixed price; and it would be very beneficial if all gas companies would do so. Another beneficial plan would be for both gas-burners and electric lamps to be maintained by some independent company for a fixed price per annum. It is not necessary to screen high-pressure lamps in the streets with some form of diffusing globe, since the intrinsic brilliancy of such mantles is very much less than that of the electric light. Experience of high-pressure street gas lighting in Berlin suggests that the eye is not too much affected by the glare of open pressure-gas lighting; but indoors it is advisable to screen high-pressure gas-lamps by some diffusing globe.



Herr M. Scholz (Director of Messrs. Ehrich and Graetz, of Berlin) says the maximum efficiency obtainable in practice at the present time is according to his experience with Graetzin high-pressure gas-lamps 4600 British candles at a gas consumption of 71·4 cubic feet, which corresponds to 64·3 candles per cubic foot. The pressure used amounts to about 54 inches of water. The highest efficiency attainable with low-pressure gas-lamps is 42·9 candles per cubic foot. This efficiency is obtained with "Triumph" Graetzin low-pressure high candle-power lamps of about 920 British candles at a gas consumption of 21·4 cubic feet per hour; and it may be pointed out that this lamp produces its highest candle power (1100) at an angle of about 40° to 50°. The above curve of this lamp shows that its light-distribution much resembles that of the high-pressure gas-lamp, and is of the best type for street lighting purposes. The high efficiency mentioned above has been obtained by superheating both the primary air

supply and the gas and air mixture. The pressure of this lamp is controlled by an automatic gas-governor arranged on top, which keeps the gas inside the lamp under a constant pressure of 1·35 inches. Another type yielding about 550 British candles at a gas consumption of 14·2 cubic feet per hour (equal to 38·7 candles per cubic foot) is being extensively employed in the lighting of Berlin. The most accurate method of expressing the efficiency of a lamp is, in my opinion, the calculation of the mean lower hemispherical candle power, the measurements of the different angles to be taken at intervals of 10 degrees. The average life of a mantle for low-pressure indoor and outdoor lighting should not be less than 500 burning hours; and for outdoor high-pressure lighting not less than 200 to 300 burning hours. It depends, however, entirely on the quality of mantle used. I do not think it desirable to provide high-pressure gas-lamps with some form of diffusing globe; the intrinsic brilliancy of these lamps not being sufficient to injure the eyes of the public, provided always the lamp is not hung any lower than 17 feet (the height of the mantles above the road surface).

MEDICAL OFFICERS AND GAS LIGHT AND HEAT.

The Electrical Press and the New Gas Lighting and Heating Arrangements at the Society of Medical Officers of Health Meeting Place.

In "Public Health"—the official organ of the Society of Medical Officers of Health—mention was made of the irritation that has been caused to the Electrical Press by the wisdom of the Society of Medical Officers of Health in making use of gas for the heating and lighting of the principal rooms—the meeting and exhibition rooms—at their offices. What transpired is reported below. Particular attention is drawn to Dr. Reginald Dudfield's remarks (printed in italics), and to the fact that the resolution, which presumably was intended to reopen the question, was lost by a large majority.

Dr. Charles Porter (Marylebone) on the plea of urgency asked the Chairman's permission to read a paragraph which had been published in an electrical paper relating to the installation of gas in the Society's premises, and which appeared to reflect upon the judgment of their Council in the matter. The paragraph having been read, Dr. Porter said he felt so strongly on the point that he would move that the whole question be referred to the General Purposes Committee for report.

The resolution having been seconded,

Dr. Reginald Dudfield (Paddington), speaking as the Chairman of the Committee who had been entrusted by the Council with the supervision of the new heating, lighting, and ventilating arrangements, said that he considered it beneath the dignity of the Society to pay any attention to *ex parte* statements published in the electrical trade press. He would merely add that *no member who had experience of their meeting-room under the old conditions could deny the improvement that had taken place since gas had been substituted for the electric light and the new system of heating and ventilation had been installed.*

Dr. Charles Sanders (West Ham) and other members strongly deprecated the proposed resolution, which, on being put to the meeting, was lost by a large majority on a show of hands.

LONDON AND SOUTHERN JUNIOR ASSOCIATION.

Visit to the Fulham Works of the Gaslight and Coke Company.

On Saturday afternoon, the members of the London and Southern District Junior Gas Association, to the number of about fifty, paid a visit to the Gaslight and Coke Company's works at Fulham. They were met on their arrival by Mr. J. W. Randell, Engineer, Mr. A. C. M'Minn, Assistant-Engineer, Mr. W. W. Scadding, and Mr. J. E. Aylott, who conducted them round the works, which were described in the issue of the "Journal" for Oct. 11 last (pp. 102, 118).

After the inspection the party assembled in the Men's Institute, where tea was provided.

The President (Mr. L. F. Tooth) subsequently proposed a hearty vote of thanks to the officers and staff for their kindness in receiving them at the works.

Mr. D. J. Winslow, in seconding, said they were grateful to the Directors and Mr. Randell for the opportunity of seeing the works and machinery that afternoon—a special feature of which was the Fiddes-Aldridge stoking machine.

The vote having been heartily accorded,

Mr. Randell, in thanking the members, said that, with reference to the Fiddes-Aldridge machine, they found it most efficient—there being a complete absence of noise and dirt. The Directors of the Company were very kind in putting in the way of all who desired to learn every information possible to enable them to improve their position. In his early days, such a state of things was not possible. It was only right that, in connection with the vote of thanks, he should mention his Assistant, Mr. M'Minn, also Mr. Scadding and Mr. Aylott, who had much to do with the clean and orderly state in which they found the works that afternoon, and which he was pleased to say was the normal state.

MANCHESTER UNIVERSITY LECTURES.

Dr. Colman on "Carbonizing."

The third lecture of the series arranged to be given at the Manchester University under the auspices of the Manchester and District Junior Gas Association, supported by the Manchester District Institution of Gas Engineers, was delivered on Saturday afternoon by Dr. Harold G. Colman, who had for his subject "Carbonizing." There was a large attendance of members of the two Associations; the Chemistry Theatre at the University being well-filled when the chair was taken by Mr. H. Kendrick, the President of the Manchester District Institution.

Mr. Kendrick, in opening the proceedings, said Dr. Colman needed no introduction from him to such an audience, and added that the two lectures which that gentleman had delivered recently in the South showed the grasp he had of his subject. He (Mr. Kendrick) believed that Dr. Colman received much of his early training at the Manchester University, and therefore would feel quite at home in delivering his lecture in that room.

Dr. Colman then delivered his lecture, which appears elsewhere in to-day's issue—see p. 707.

Mr. S. Meunier (Stockport), in moving a vote of thanks to Dr. Colman, said he had listened very carefully to the lecturer, half expecting they might have something definite laid down on the subject in hand for their guidance. However, he was not surprised at the caution displayed by Dr. Colman in giving them the results of many years' experiments on the question of carbonizing, especially having regard to the complexity of the subject. Dr. Colman had told them if they did so-and-so they would get such and such results; but if, on the other hand, they tried something else, they would probably get better results. So it seemed to him (Mr. Meunier) that, in their efforts, by a sort of rule-of-thumb, without absolute scientific experience, they had come out "there or thereabouts." The point with them as gas engineers was how to get the best financial results and maximum yield per ton of coal; and it was the scientific work of such men as Dr. Colman and Professor Harold B. Dixon that would help them to attain this end.

Mr. T. Duxbury (Oldham) seconded the motion. He said that Dr. Colman had laid before them several important points which they could with advantage investigate for themselves in their spare moments. He was particularly interested in the suggestion that what they should aim at was a uniform quality of gas. This he regarded as being most important. He believed if they could give a uniform quality of gas throughout the 24 hours, greater satisfaction would result to the consumers; and it was his opinion that vertical retorts were going to help them very considerably in securing uniform results. Dr. Colman's remarks on the chemical manufacture of gas were deeply interesting; and he (Mr. Duxbury) would have liked to hear more on this part of the lecture. At one time, he thought Dr. Colman was going to tell them what maximum heat was required in the retort before the fuel began to deteriorate; but he seemed to stop short. He quite understood why Dr. Colman did this. It was because almost every coal required a different maximum temperature. He would like to put down a plant himself for a week or a month's run with a particular coal, to find out the maximum heat required before it began to deteriorate. They ought to investigate this matter independently—say, with Barnsley or Wigan coal—and he was certain such experiments would be of use to them. He agreed with Dr. Colman that the higher the heat the larger make per ton they obtained, and that, although there was a greater amount of naphthalene, they had a cheap way of overcoming this difficulty.

Professor Harold B. Dixon supported the vote. In the course of his remarks, he expressed the hope that Mr. Duxbury would summon up courage and carry out the experiments he had mentioned with regard to different classes of coal.

Dr. Colman, responding, agreed that he had not dealt as fully with some parts of his lecture as he might have done. His whole difficulty had been to compress his remarks into an hour—he had exceeded this time as it was—and he had not known exactly what to leave out on this most complex subject. He had intended to say that if they could, by controlling the reaction in some way—and he had reason to believe that it could be done—increase the amount of methane produced and that coming over the coke, it would be of the highest importance, even if it was 1 per cent. With reference to Mr. Meunier's observations, in these complex things they had to balance the advantages against the disadvantages of particular processes, and adopt that which possessed the maximum of advantages and the minimum of disadvantages. And what might be found to be of advantage at one place, would be a disadvantage at another. It was not for him to take away from a gas engineer the responsibility of finding out and deciding what was best suited for his particular purposes. He was prepared to agree with Mr. Duxbury as to the advantages of having a uniform quality of gas. He believed, in spite of legislative procedure, that to have a uniform quality of gas was of much more importance than what that quality should be. Further, gas ought to be supplied at a uniform pressure.

This concluded the proceedings at the University. Members of the Association, however, held a meeting subsequently, at which various points raised in the course of the lecture were discussed among themselves.

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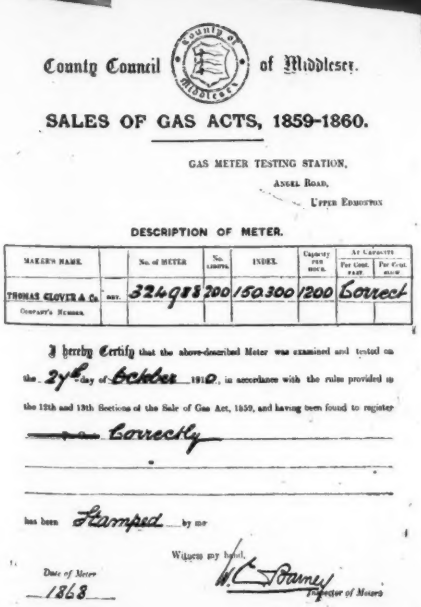

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RETORTS v. LARGE CHAMBERS FOR A MAKE OF 750,000 CUBIC FEET OF GAS PER DIEM.

At a Meeting of the Mid-Rhenish Association of Gas and Water Engineers held recently at Gmünd, interesting accounts were given of experiences with different types of carbonizing plant for works having a productive capacity of about 20,000 cubic metres (about 700,000 cubic feet) per diem; and a general discussion ensued. The following brief account of the proceedings is taken from the full report in the "Journal für Gasbeleuchtung."

The President of the Association, Herr Frahm, Manager of the Baden-Baden Gas-Works, called upon Herr Käfer, the Manager of the Frankenthal Gas-Works, to open the debate by giving an account of the working and results of an installation of Klönne horizontal carbonizing chambers which had been in operation at his works for some time past.

Horizontal Chambers.

Herr Käfer said that it had been decided a year and a half ago, after much deliberation, to instal the plant referred to at Frankenthal. Horizontal chambers had been preferred to inclined on account of their being less costly; and, notwithstanding the favourable views held by many gas engineers as to vertical retorts, it seemed to him that for a works such as that at Frankenthal, where the annual make of gas was about 70 million cubic feet, corresponding with an average make per diem in the summer months of about 160,000 to 175,000 cubic feet, and in the winter months to as much as 350,000 cubic feet, large chambers were more suitable. He had not anticipated, however, that the working of the chambers would be so convenient as it had proved to be. Primarily the cessation of night-work was an advantage which could only be properly appreciated by those who had experienced it. At night, they had now only one mechanic and one boiler fireman at work. The settings were looked at hourly by the mechanic to see that all was in order. He also charged the producers from a special charging waggon when required. The next most important factor was the reduction of labour. Formerly about 15 men were employed in the retort-house and yard. Now only six men were required.

Six months' working experience had shown them that the large chamber was not too great a carbonizing unit for works of the size of those at Frankenthal. They had two settings of three chambers and one setting of four chambers. The chambers were 17·2 feet in length, 7·2 feet in height, and had an average width of 1·4 feet. They were slightly wider on the discharging side. Early in March, when the installation was first brought into use, the setting of four chambers and one setting of three chambers were required; and all the chambers were charged once in twenty-four hours. Subsequently, the chambers in the setting of four were charged once in twenty-four hours, and those in the setting of three once in 36 hours. Later, for some time, work was interrupted on Sundays, and, later still, the setting of three chambers was only charged once in 48 hours, and finally wholly dispensed with. Thus in the summer months the setting of four chambers only was at work; and this was kept in regular use. It will be seen therefore that the working of chamber settings can be readily accommodated to the fluctuations in the output of the works. Latterly the reverse procedure has been followed, and a setting of three chambers has been brought into use—in the first instance, with 36-hour charges.

The speaker was of opinion that large chambers could be adopted with advantage even by smaller gas-works than those of Frankenthal, especially if a setting of four chambers was divided so that two could be worked alone. As to the relative merits of horizontal or inclined chambers, he had not had experience of the latter; but as Herr von Gässler, of Hanau, would subsequently speak in regard to them, those present would be able to form their own opinion as to which system was really best. In his view, local conditions must influence the choice considerably. The chambers at Frankenthal were charged for the first time on March 2 last, and the old carbonizing plant was put out of action on March 4. Diagrams and tables are given, showing the make of gas per ton of coal on each day from March 15 to Aug. 31 last, and the calorific power of the gas. The average make per ton of coal in this period amounted to 12,484 cubic feet. The maximum make per ton on any one day was 13,634 cubic feet, and the minimum make, 10,765 cubic feet; the latter being on the days when the working was partially suspended. In regular working, the make only twice fell below the average of 12,484 cubic feet; and in these cases the coal carbonized was of the description usually supplied to coke-ovens.

Excluding the two occasions of low make, the average yield of gas per ton of coal from the middle of May to the end of August was 12,739 cubic feet. It might therefore be assumed that in regular working, year in and year out, a make of over 12,560 cubic feet per ton of coal would be secured. This was without the admission of steam. Ordinarily, the chambers were charged at 8 o'clock in the morning and 3 o'clock in the afternoon. The make of gas per hour rose immediately after charging; but the calorific power, which was taken by a Junkers' recording calorimeter, began to rise 1½ to 2 hours after charging. The diagrams showed, however, that the calorific power of the gas produced over the twenty-fours varied only between the limits of about 522 and 627 B.Th.U. per cubic foot. Quite commonly the fluctuations covered a much less wide range. The coke consumed in heating the chambers amounted to 14·8 per cent. by weight of the coal carbonized. The producer was charged with freshly-quenched coke containing a good deal of moisture; and if the fuel consumption were reckoned as dry coke and the coke recovered from the clinker was deducted, the amount of coke consumed became 12·2 per cent. The yields of tar and ammonia were not determined. There were no stopped ascension pipes. Scurf forming on the walls of the chamber was expelled with the slab of coke. The use of chambers in place of retorts at Frankenthal has resulted in a saving on coal of about £1000, and on wages of about £600 per annum. The coke-expelling machine was driven by electric power, and had given no trouble. No complaints had been received of want of uniformity in the quality of the gas.

Inclined Chambers.

Herr von Gässler, the Manager of the Hanau Gas-Works, next spoke with special reference to the installation of Munich carbonizing chambers at his works. He pointed out first that the determining factor in the choice of a system of carbonizing plant ought not to be simply its initial cost, but that durability, trustworthiness, and cost of repairs ought to be taken into consideration also, as well as the make of gas and the fuel consumption. After weighing all these points, he had decided to recommend the adoption of Munich carbonizing chambers at Hanau; and they now had an installation of eight settings, each containing three chambers of this type, guaranted to give an output of 1,130,000 cubic feet per diem. Though the total gasholder capacity of the works was only about 630,000 cubic feet, and therefore very small relatively to the output, so that there was no opportunity for mixing gas of very variable quality if such had been produced, actually no trouble had ensued on this account. The fluctuations of make every hour were no larger than with retorts. The chambers were charged once in twenty-four hours; and the gas made was passed into the largest holder, and thence direct to the town. The calorific power of the gas distributed was ordinarily between 522 and 543 B.Th.U. gross per cubic foot. A large proportion of the gas sold was employed for technical purposes, such as brazing and melting metals, and for gas-engines; and no complaints had been received consequent on the change from retorts to chambers.

When three settings were in use, the retorts in one were charged at 7 o'clock in the morning, in another at 11 o'clock, and in the third at 5 o'clock in the afternoon. This arrangement distributed the work and the make of gas fairly uniformly. At night there was only one man in the retort-house to charge the producers and watch the working. The cessation of night work had been found a great advantage. Two stokers were employed in the daytime, and while charging was actually in progress they were assisted by a fitter, who attended to the quenching of the coke and to the opening of the doors; but at other times he was employed in the shops. About a quarter-of-an-hour was occupied in discharging and recharging the three chambers of a setting; the charge per chamber being about 4·13 tons of coal. The time might be somewhat longer if the charge did not slide out of a chamber at once. This might occur if the charge were not fully worked off, or if there were much scurf, or if, through carelessness, the chamber had been overfilled so that coal had been left in the necks through which the chambers were charged and had consequently not been properly worked off. Generally speaking, at least 90 per cent. of the chambers discharged themselves automatically; and the services of the expelling machine were requisitioned in not more than 3 per cent. of the remainder. The chambers were scurfed once in three weeks by allowing air to pass through before recharging, and removing the loosened scurf by means of long rakes.

The cramped site available for the carbonizing house at Hanau had been a predominant factor in determining the type of plant to be put in it; and it had been found that no other system required so little space for the settings for a given capacity as the Munich carbonizing chambers. The whole bench of eight settings, inclusive of very stout end columns, covered an area of only 2210 square feet, and the retort-house, including chimney, occupied only an area of 4748 square feet. In direct connection with the retort-house was a Rank's inclined coal-tank of 6000 tons capacity, constructed in reinforced concrete. This occupied an area of only 4496 square feet. By the adoption of the Munich chambers and this coal-storage tank, there had been obtained, instead of the former productive capacity of 283,000 cubic feet per diem, one of 1,130,000 cubic feet; and the arrangement admitted of this being doubled without more land being required. Having regard to the high cost of other available sites for a gas-works in Hanau, the relatively expensive Munich chambers had in this instance proved extremely economical.

The results of a four days' working trial of two of the settings, in which nuts from the Saar pits of Altenwald, Maybach, and Dudweiler were carbonized, were given. One setting was charged at 5 o'clock in the afternoon and one at 7 o'clock in the morning; the charge averaging 4·11 tons per chamber. The total amount of coal carbonized was 98·68 tons, containing, on the average, 6·62 per cent. of ash and total moisture 8·09 per cent. The total volume of gas made, corrected to 60° Fahr., 30 inches, and saturated, was 1,331,740 cubic feet. This gave a make of gas per ton of coal carbonized of 14,399 cubic feet, or, per ton of dry and ash-free coal, of 15,726 cubic feet. The average gross calorific power was

553 B.Th.U. per cubic foot at 60° Fahr. and 30 inches. The coke used as fuel contained 9·95 per cent. of ash and 10·11 per cent. of total moisture. The total consumption of coke amounted to 14·35 tons. This worked out to a consumption of dry and ash-free coke of 11·77 per cent. by weight of the coal carbonized, or 13·71 per cent. of the ash-free and dry coal. The fuel consumed amounted to 19·6 lbs. of ash-free and dry coke per 1000 cubic feet of gas made. The average temperature in the lower heating passages of the settings was about 1260° C., and in the chambers 1040° C. The make of gas per diem per chamber averaged 55,348 cubic feet.

After some remarks by Herr Heinrich, the Manager of the Pforzheim Gas-Works, in the course of which he asked for definite figures which could be checked as to the make obtainable with the 1910 pattern of Dessau vertical retorts, which were stated by Dr. Geipert to be superior to carbonizing chambers, the President asked those present who had had experience of vertical retorts to give their views on their working; and after they had spoken, Dr. Blum, of the Berlin-Anhalt Engineering Company, would conclude the proceedings by addressing the meeting.

Vertical Retorts.

Herr Röhrich, the Manager of the Offenbach Gas-Works, said that the installation of vertical retorts at his works had proved satisfactory; the make of gas per ton of coal, with steaming, averaging 13,098 cubic feet, and the fuel consumption amounting to 15·5 lbs. of coke per 100 lbs. of coal carbonized.

Herr Foertsch, the Manager of the Gas-Works at Ludwigshafen-on-the-Rhine, said that the installation of vertical retorts there was one of the first introduced in South Germany; having been erected four years ago. They had proved satisfactory, and any difficulties which had occurred were due to the nature of the coal used. If the block of coke hung-up in the retort, it was not an easy matter to get it out, and the man below had to be careful to avoid injury from it. Ordinarily, the make of gas averaged 11,842 cubic feet per ton of coal; and the coke consumed as fuel amounted to 15 per cent. by weight of the coal carbonized.

The President, having drawn attention to the difference in the makes of gas quoted by the speakers—11,842 cubic feet per ton at Ludwigshafen with vertical retorts, 12,560 cubic feet per ton at Frankenthal with horizontal chambers, and 13,634 cubic feet at Hanau with inclined chambers—asked Herr von Gässler if he would say if the last-named result referred to an exhibition trial or to ordinary working. Herr von Gässler replied that the figures quoted were not for a trial in exceptional conditions, but that they had at times been surpassed in regular working. He had brought his carbonizing book with him, and asked those present to verify the results which he had quoted.

Dr. Blum, of Berlin, said that both vertical retorts and the different systems of carbonizing chambers presented an enormous advance in methods of carbonizing and afforded a greatly increased make of gas. That the vertical retort was to the fore was due to the circumstance that experiments had been made under the guidance of Dr. Bueb at Dessau for many years, and, therefore, the Dessau Vertical Retort Company were able to put forward a type which was the result of prolonged testing and experience. Consequently, Dessau settings had been introduced into a very large number of gas-works, and repeat orders had been placed by numerous gas-works where they had been tried. The new, or 1910, type of Dessau setting was at the present time being introduced at the Mannheim and Frankfort Gas-Works. The trials at Mariendorf made with it by the Carlsruhe Instructional and Experimental Works had shown that it had afforded further economy of fuel and an increased make of gas, but at the same time the Munich carbonizing chambers had been elaborated and further improved by Herr Ries, the Manager of the Munich Gas-Works; so that results such as those just communicated by Herr von Gässler were obtainable from them.

Horizontal chambers had been more recently put on the market; and Herr Käfer had reported results obtainable with them. But they had not yet been long in use; and it remained to be seen whether they could be kept sufficiently sound to prevent the nitrogen in the gas becoming excessive in quantity. The firm of Koppers had introduced both horizontal and inclined chambers; but comparative working figures had not yet been obtained in Germany with them. After referring to the doubts at one time felt in the gas industry as to the advantages of inclined retorts and of producers for heating retort-settings, and expressing the view that the doubts now similarly expressed as to the merits of the new systems of carbonization would be equally dispelled in a short time, the speaker went on to say that the system of carbonizing which should be preferred was one which, in addition to giving the highest yields of gas, ammonia, and tar, required the smallest amount of attendance and adapted itself in the simplest way to the supply of the coal and the removal of the coke, while showing favourable figures in regard to repairs and maintenance.

Results obtained at different gas-works were only comparable if they were on the same basis and, in particular, if they were obtained from the same coal. It was therefore desirable that the Carlsruhe Instructional and Experimental Gas-Works, which had already carried out trials of vertical retorts at Mariendorf and Zürich, should be given the opportunity to make similar trials on the other systems of carbonization. It remained for the manager of every gas-works to form his own opinion from what had been communicated as to which system was preferable. There was no doubt that for the size of works under discussion all the types of carbonizing plant mentioned were applicable. So much must depend on local conditions; it was not everywhere, for instance, that settings could be erected in the open without protection from rain and snow, as had been done at Innsbruck. Such a procedure cheapened the cost of installation, but was not in keeping with German views as to improvement in the conditions for the workmen. The method of bringing in the coal and taking away the coke also must depend largely on local conditions, and the coke could be removed more simply from vertical retorts than from chamber settings in most cases. On the other hand, with large installations like Munich, Regensburg, and Hanau, the method of coke removal left nothing to be desired.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

A Meeting of the Western Division of the Scottish Junior Gas Association was held in the Technical College, Glasgow, on Saturday evening. There was a good attendance, presided over by Mr. J. Frazer, of Provan, the President for the year.

Mr. G. Braidwood (Coatbridge) read a paper on the subject of

THE CALORIMETRY OF FUELS.

To determine the calorific value of a solid or gas, the combustion is carried out under such circumstances that the whole of the heat liberated is communicated to a known volume of water at a known temperature; such determination being carried out by means of instruments known as calorimeters. The calorific value of coal gas is a subject which is assuming more importance daily. When we consider that, with the sole exception of flat-flame burner lighting, gas is sold for fuel purposes, and that all fuels are valued chiefly by their heating powers, it seems right we should fall into line by adopting a calorific power standard, and abolish the illuminating power test, which has now become, or is fast becoming, obsolete.

That the test for illuminating power must be abolished sooner or later there can be no doubt; for if coal gas is to improve, or in fact retain, its position in the fuel field, it must be freed from unnecessary restrictions, which, by limiting the use of lower grades of coal in its manufacture, makes its price prohibitive for general fuel purposes. It is held by some that a relationship exists between illuminating power and calorific value; but experimentalists have entirely failed to evolve an algebraic formula which meets the case of gases of varying candle power. Much work has been done in attempts to prove such relationship; but he would be a bold man indeed who would state a definite calorific value for a given candle power. In the fixing of a calorific standard, the fact should not be lost sight of that, for incandescent lighting, gas of a high flame temperature is of more value than one of high calorific value.

The calorimetry of solid fuels may still be considered of secondary importance with us as gas engineers; but why this should be, I have long been at a loss to understand. The agitation in favour of smoke prevention in manufacturing centres should awaken gas engineers to the fact that they have in coke probably the best smokeless fuel in existence, and as such its calorific power is of paramount importance. The calorific value of coal is a matter which is entirely ignored by gas engineers in this country; but it is a significant fact that German engineers are already quoting their carbonizing results in percentage of the total heat units of the coal used. With a knowledge of the calorific value of our coal, coke, and gas, the loss of heat units to the tar-well would be interesting and instructive knowledge.

Before proceeding to describe the different types of calorimeters in general use, a few notes on the construction and corrections common to all the types may be of interest. In the construction of calorimeters, every care is taken that the material of which they are made should absorb as small an amount of heat as possible, and also that heat should not be lost by radiation. These results are obtained by having the metal of which the instrument is constructed as thin as is consistent with strength, and highly polished. Perhaps the most important part of a calorimeter is its thermometers, as the accuracy of an experiment is wholly based on their being correct. Mercury-glass thermometers are not by any means faultless, and should, where certainty is desired with regard to their accuracy, be tested against a standard thermometer, and the true reading at various points along the scale noted. When once fitted into their places, they should not be disturbed.

It has been suggested with flow calorimeters to change the inlet with the outlet thermometer at regular intervals; but I do not approve of this course, as it is well known that when a thermometer is first used for a low temperature, then exposed to a high one, and finally brought back to the first low temperature, it will give a lower indication than before. The effect is due to the glass not contracting at once to its original volume on cooling; the contraction sometimes taking days. The most important correction with solid-fuel calorimeters is that of water value or water equivalent of the apparatus, which value varies according to the amount of heat absorbed by the material of which the instrument is constructed. This value may be obtained by

taking the weight of the different parts of the calorimeter and multiplying by their respective specific heats. Should the vessel be of glass, only that part in contact with the water is taken; but if of metal, owing to its higher conductivity, the whole is taken.

Another method, and perhaps a more practical one, is to burn a known weight of a substance of a known calorific value and note the loss. There are a number of pure substances suitable for this purpose. A correction must also be made for the fuse employed. The heat developed by the fuse may be found by burning a certain weight of it. Where a high degree of accuracy is required, a correction must also be made for loss due to radiation. With the bomb type of calorimeters, this correction is carefully arranged for; but with the ordinary constant pressure type, a sufficiently accurate result may be obtained by having the temperature of the water at the beginning of the experiment 1·5° below that of the room. The rise of temperature usually being about 3°, the heat absorbed by the apparatus before reaching room temperature roughly equals that given off by radiation.

The essential parts of all solid fuel calorimeters are the combustion chamber and the calorimeter vessel. The calorimeter vessel is usually beaker shaped, made of copper, silver or nickel plated to prevent loss of heat by radiation. As a further guard against radiation loss, the vessel is usually surrounded by an outer casing having an air space between. The combustion chambers vary according to the type of calorimeter, but may be divided into three classes. (1) That in which the substance is burned with oxidizing substances, as in the Lewis Thompson calorimeter. (2) Calorimeters in which the substance is burned in a stream of oxygen at slightly above atmospheric pressure; this type being known as constant-pressure calorimeters. (3) Where the substance is burned in oxygen at an initial pressure of about 25 atmospheres in a closed vessel known as a calorimetric bomb.

In the first and second types, the products of combustion escape; but with the bomb, all the products are confined, and so no heat is carried away. There are hosts of solid-fuel calorimeters on the market; but the three which I propose to deal with will serve to illustrate the different types.

The Lewis-Thompson type of calorimeter is very common—being found in most laboratories. But, unfortunately, where a reasonable degree of accuracy is desired, its use cannot be recommended. Its faults are many, and are too well known to require repetition.

In the Parr calorimeter, as in the Lewis-Thompson, the substance is burned in the combustion chamber with an oxidizing mixture; but with this difference, that the products of combustion unite with the oxidizing agents. The combustion chamber consists of a cylinder of german silver, the bottom of which is closed by a screwed plug, while the top is closed by a conical valve held shut by a spiral spring. It is through this valve that a short piece of hot nickel wire is dropped into the chamber, to ignite the charge while the calorimeter is running. Vanes are sprung on to the sides of the chamber to cause a thorough circulation of the water in the calorimeter vessel; the chamber being revolved by means of a small electric motor. The calorimeter vessel is insulated by two outer casings, with air spaces between; while the vulcanite lid is provided with suitable openings for the spindle of the combustion chamber and thermometer. The oxidizing agents used in the combustion chamber are sodium peroxide, tartaric acid, and potassium persulphate, in different proportions for different classes of coal.

The proportions and weights of coal used are as under:—

	Lignites.	Bituminous.	Anthracites.
Coal	1 gm.	0·5	0·5
Tartaric acid	—	0·5	0·5
Sodium peroxide	10 gm.	10·0	10·0
Potassium persulphate	—	—	1·0

The coal must be small enough to pass a sieve 0·3 m.m. mesh and thoroughly dried at 105° to 110° C. to prevent premature ignition of the charge by moisture. To make an experiment, the combustion chamber, with its contents and stirring vanes in position, is placed in the calorimeter vessel containing 2000 grammes of water at 1·5° C. below room temperature, the cover put on, the connection made with the motor, and stirred for five minutes, when the initial temperature is taken. The small length of nickel wire is then heated to redness, and dropped into the bore of the spindle without stopping the motor, and the valve depressed, when the charge will ignite; the maximum temperature, when reached, being then noted. The reaction of the products of combustion with the sodium peroxide gives 27 per cent. of the total heat evolved; and, consequently, 73 per cent. of the heat is due to combustibles. Of course, in all cases the heat due to the iron wire, tartaric acid, and persulphate (when used) is deducted from the observed rise. The weak part of the apparatus is in the correction due to the chemical reactions, which varies with different classes of coal. Errors of from 1 per cent. to 1·5 per cent. high may be expected with the apparatus, although experimentalists are not agreed as to the maximum error. The instrument, naturally, can only be recommended for use where a supply of oxygen is not available.

The Gray-Thompson calorimeter, of the constant-pressure type, was originally of the William Thompson design, but has been considerably modified by Dr. Gray, of the Glasgow and West of Scotland Technical College, which modifications considerably enhance its value as an instrument of accuracy. The most important alteration is in the uprights, which have been arranged to allow of electric ignition. Alterations have also been made in the glass combustion chamber and baffle-plates; while means have been adopted to gauge the rate of oxygen passing through the apparatus, and to show the pressure. The instrument consists of a glass calorimeter vessel, capable of containing rather more than 2000 grammes of water, enclosed in a metal jacket, electro-plated to prevent radiation. The combustion chamber consists of a glass bell about 6½ inches long by 2 inches in diameter, which sits loosely on a perforated metal base.

A brass tube for supplying the oxygen passes through a thick walled rubber tube fitted over the drawn-out end of the combustion chamber. Fixed to the metal base are two brass tubes joined at the top by a vulcanite cross-piece, and provided with terminals to transmit the current for igniting the charge. The tubes are in metallic connection with the metal base, and through one of them an insulated wire passes from the terminal to a short insulated vertical rod inside the combustion chamber. A second rod, bent in the form of a ring to support the crucible in which the coal is burned, is in metallic connection with the base. The upper ends of these two rods are on a slightly higher level than the top of the crucible, and are connected by means of a thin plantinum wire, which can be made to glow by the passage of an electric current. To carry out an experiment, one gramme of the coal, if of a bituminous nature, is compressed in the form of a pellet and attached to the thin platinum wire by means of a piece of sewing cotton, and dropped into the crucible. The combustion chamber is then lowered on to the base, and held in position by the screw fixed in the cross-piece. In the case of anthracite or coke, which cannot be made to form a pellet, the fuse is inserted into the powder in the crucible. Moist oxygen is then passed through the combustion chamber at a rate of 2 litres per minute, which is then immersed in the calorimeter beaker containing 2000 grammes of water, the temperature of which is 1·5° to 1·75° C. below that of the room.

After an interval of ten minutes, the temperature of the water is read to 1·100° on a thermometer graduated in tenths, with the aid of a lens. The fuse is then ignited by connecting up to the battery. When the combustion is complete, the rubber tube connecting the oxygen supply with the calorimeter is detached, to allow the water to enter the combustion chamber, when the water is thoroughly stirred by using the apparatus as a stirrer. Connection is again made with the oxygen supply, to continue the mixing, when the maximum temperature is observed. The calorific value is calculated thus:

$$\frac{(2000 \text{ water value})\ (t_1 - t_2) - \text{Fuse correction}}{\text{weight of coal}} = \text{calories per gr.}$$

Determining the water value of the instrument by the standard coal method, results from 0 per cent. to 1·5 per cent. low may be expected with bituminous coals; the error being due to the escape of gaseous hydrocarbons whose complete combustion is difficult.

The Langbein calorimeter, a modification of the Berthelot—one of the many types of bomb calorimeters on the market—has been found to give excellent results. The combustion chamber consists of a nickel-plated mild steel bomb, lined with platinum foil, of 300 c.c. capacity, tested up to a pressure of 2000 lbs. per square inch, with a lid which is capable of being screwed firmly on; a lead washer ensuring a gas-tight joint. Through the lid passes the entrance gas-channel, which is fitted with a needle valve. The entrance tube is continued into the bomb, and acts as an electrode, the other electrode also passing through the lid, but insulated from it. To determine the calorific value of coal, 1 gramme is impressed into a pellet, the fuse attached, and connected to the platinum wire, through which the current passes from an electric battery. 2172 grammes of water at room temperature is weighed out and placed in the calorimeter vessel, while 10 c.c. of water is added to the bomb, and the cover to which the coal is supported screwed on. Oxygen at an initial pressure of 25 atmospheres is then added to the bomb, which is transferred to the vessel containing the 2172 grammes of water. The wires are then connected to the bomb, and the calorimeter vessel covered with the vulcanite plates.

The stirrer, which is driven by an electric motor, is then started, and readings taken every minute for five minutes, at the end of which time the combustion is started by making the connection between the wires and the battery. The temperature rises quickly, reaching the maximum in about three minutes, when it begins to fall gradually; readings being taken during the fall for five minutes to obtain the cooling correction.

The stirrer is then stopped, and the bomb removed from the water, the top removed, and the contents of the lower part of the bomb washed into a beaker with water. The amount of sulphuric and nitric acid formed during the combustion is then estimated to find the number of calories to deduct for the formation of same. This is found by boiling the liquid washed out from the bomb, to eliminate carbonic acid, and titrating $H/_{10}$ $Ba(OH)_2$, using phenolphthalein as an indicator:—

$$2\ H\ NO_3 \quad Ba(OH)_2 = Ba(NO_3)_2\ 2\ H_2O$$
$$H_2SO_4 \quad Ba(OH)_2 = BaSO_4 \quad 2\ H_2O$$

Twenty c.c. of Na_2CO_3 of 3·706 grammes per litre strength is then added; 1 c.c. of this solution being equal to a quantity of HNO_3, in forming which one calorie is liberated.

$$Ba(NO_3)_2\ Na_2\ CO_3 = Ba\ CO_3\ 2\ Na_2\ NO_3$$

Filter, and to the filtrate add methyl orange, and titrate with

N/10 HCL. One c.c. N/10 HCL being equal to 1·429 c.c. Na_2CO_3, the correction for HNO_3 may be stated thus: 20 − 1·429 N/10HCL. The percentage sulphur in the coal may be calculated from the figures obtained:

$$\frac{(\text{HCL } Ba(OH)_2 - 14) \times 0{\cdot}16}{\text{weight of coal in grammes}} = \text{percentage of sulphur.}$$

For every 1 per cent. of sulphur, a deduction of 22·5 calories must be made.

In the fitting up of a gas calorimeter, too much attention cannot be paid to having a water supply of constant pressure and uniform temperature. This is best attained by having a water-tank fixed overhead in the same room as the calorimeter. The tank should contain sufficient water to make a number of tests, and have an arrangement fitted to shut off the gas supply from the calorimeter, should the tank be allowed to empty itself by accident. The room in which the calorimeter is fitted should be free from draughts and vibration, and capable of being maintained at a steady temperature. The governed gas supply to the calorimeter should be registered by an experimental wet meter, registering directly from the drum, and not one geared to the index.

One is rather at a loss where to begin a review of the gas calorimeters at present on the market, most of which are thoroughly reliable instruments. Perhaps the calorimeters which have met with most success in this country are the Junkers and Simmance-Abady instruments for general oil and gaseous fuel testing; while the Boys calorimeter has been introduced with success for testing coal gas only. The Junkers and Féry recording calorimeters, with the necessary correction for temperature and barometric pressure, can be relied on for accurate results, and, as well as providing an indisputable record, are of much more value in checking the make than an occasional laboratory test by the ordinary method.

The general construction of the calorimeters mentioned is well-known to you; so I will confine my remarks to the good or bad points in their design which have appealed to me when working them.

The Simmance-Abady calorimeter, although perhaps among the cheapest on the market, is by no means the worst. This calorimeter, in one form, may be used for testing any combustible gas or oil. The water, passing upwards through concentric annular spaces, has a passage of 96 lineal inches. By means of a mirror, fixed at an angle on the burner, the flame is visible throughout a test; while the water pressure can be watched in a gauge fitted beside the thermometers. The mirror possesses an obvious advantage; but it is questionable if the water-gauge is quite as good as the arrangement on the Junkers and Boys instruments, having an overflow to waste; thus ensuring a constant head, no matter from what source the water is drawn. A distinct advantage in intermittent testing is that the burner may be placed exactly in position, without adjusting screws or disturbing the apparatus in any way. It is claimed for this apparatus that an actual test may be made under one minute; but while this point may appeal to many, my experience has been that speed in experimental work does not always tend towards accuracy. The calorimeter is well adapted for intermittent testing.

The Junkers calorimeter, introduced at a much earlier date than the Simmance-Abady or Boys instruments, has met with much favour on the Continent and in this country. Like the Simmance-Abady instrument, it is adapted for the testing of all combustible gases and oils. Unfortunately, its price is high, and this will no doubt act as a bar to its introduction to works where a reliable instrument at a fair price is required. The arrangement for regulating the water rate of flow through the instrument by means of a quadrant cock is very useful, and permits the operator to increase or diminish the flow through the calorimeter without moving about; while the overflow funnel insures a constant head. The instrument can be recommended for sound construction, ease of working, and accurate results.

The Boys calorimeter, prescribed by the Gas Referees for use in London, serves the purpose well for which it is intended—namely, testing the calorific value of coal gas of about 14 candles. Constructed on entirely different lines from the Simmance-Abady and Junkers instruments, there is room for improvement in its design. Flat-flame burners are used for the combustion; and it is doubtful if complete combustion can be obtained with richer gases. Perhaps a more serious fault is that to light the burners the body of the calorimeter must be lifted off its stand. This, in a works where intermittent testing is required, is a bad point; and the average assistant is not blessed with the patience necessary to await the proper flow of condensed products from the disturbed reservoir. In the hands of an experienced operator, however, very consistent results may be obtained. The apparatus lends itself to repair much better than either the Junkers or Simmance-Abady instruments.

The Junkers recording calorimeter, very much like the ordinary Junkers in design, is fitted with a meter arranged to pass constant quantities of gas and water. The quantities of gas and water passed being fixed, it follows that any rise of temperature is due to an increase in the calorific value of the gas. By means of a thermocouple, any alteration is communicated to a galvanometer or recording chart. The apparatus records gross value, which, of course, requires correction for temperature and atmospheric pressure. As the instrument is intended only to keep a check on the manufacturing process, absolute figures need not be expected.

The essential parts of the Féry recording calorimeter consist of a thermocouple, heated by the products of combustion of a flame, and connected by two conducting leads to a thread recorder. The thermocouple is formed of 15 vertical strips of nickel and constantan soldered in series, and insulated from one another by sheets of asbestos. These strips are placed inside a brass cylinder standing upon an insulating plate supported by two feet. The gas under test is passed through a meter, then through a regulator to the burner, and burns in the centre of the space formed by the strips, and between their upper and lower junctions. The products of combustion escape between the spaces in the upper junctions which they heat. The air necessary for combustion passes between the lower junctions, which remain at the temperature of the room.

The vertical strips are cooled by a current of air passing inside the brass cylinder, which is pierced with holes at its lower part. The temperature of the hot junctions is not raised above 200° C. under ordinary working conditions, the junctions therefore do not deteriorate with use. The difference in temperature between the hot and cold junctions gives rise to an electromotive force which is proportional to their difference in temperature. Being arranged differentially, the difference of potential between the thermocouple junctions is not influenced by variations in the external temperature. Experiments with the calorimeter have shown that, within very wide limits, the electro-motive force is proportional to the calorific power. The difference in potential is registered by means of a thread recorder, which is arranged to show net calories. The calorimeters are standardized in 1000 calories—viz.: From 1000 to 2000 for petroleum gas; from 2000 to 3000 for water gas; and from 4000 to 5000 for coal gas.

In closing, I may say that it was my intention to bring before you a number of experimental figures; but a change in my position made this impossible. Without the intended figures, the paper has less value.

Discussion.

Mr. T. Wilson (Coatbridge) said the members were all much indebted to Mr. Braidwood for the time he had taken in preparing the paper; but he had not given them matter for discussion. The possibility was that they would learn much more in reading than in discussing it.

Mr. J. Wilson (Falkirk) said Mr. Braidwood's observations on the subject of thermometers were exceedingly interesting to him. He thought at first that the changing of thermometers was a good idea; but he was afraid he was now beginning to alter his opinion. The members might have entered the room with a little knowledge of calorimetry; but he was sure this would not be the case when they left, because they would have learned a great deal in the short time Mr. Braidwood had been reading his paper.

Mr. F. Cuthbert (Kirkintilloch) considered that in the case of gaseous fuel it was a proved fact that the products of combustion should have the same temperature as the ingoing water; otherwise all the heat would not be registered by the thermometer, and consequently a false result would be obtained. He understood that with the Boys calorimeter, though it required a longer time to make a test, the accuracy of the experiment was much greater than in the case of other instruments. In all the calorimeters on the market, the essential feature was that the whole of the heat of the burning gas was transferred to the water circulating through the instrument, and also that it should be well insulated. He was pleased to see that the author approved of thermometers being always used at the standard.

Mr. F. L. MacLaren (Dumbarton) said it was refreshing to get the different points about calorimetry brought up to date and presented so carefully. He much appreciated the electrical ignition of the calorimeter. He recollected the trouble they had in bygone days to ignite their charges by means of a fuse; and very often they failed half-a-dozen times before they succeeded in getting one proper result. He noticed the bell-shaped glass jar, and was wondering how it stood the heat. He remembered that they used to break very frequently. But an ingenious individual devised an arrangement with an incandescent vertical funnel, with a plug at the end and a tube screwed tightly into it; and the hard glass stood up to the great heat of combustion, whereas the cast glass bell very often gave way with the difference in temperature between the water outside and the hot gases within. However, he had no doubt it would be perfect now. Certainly the electrical igniting arrangement was good.

The President remarked that Mr. Braidwood had had a very long and varied experience in connection with calorimetry in the laboratory; and what he had just given the members was the outcome of that experience. One thing he (the President) noted—and he might say he expected Mr. Braidwood would touch upon it—was the general idea which was gradually spreading in the gas industry, that with the advent of incandescent lighting the illuminating value of gas was of less account than its calorific value or flame temperature. Mr. Macfarlane, their Chemist at Provan, had been making quite a series of tests of the calorific value of the gases for the purpose of ascertaining the real difference between the illuminating and the calorific value. He was surprised to notice, from time to time, that when the gas was of fairly high illuminating power, the calorific value was low, and that when they had a low candle power the calorific value was high. They knew the reason for it; but the value of the fact was that it went to point to them that the improved heating value of gas was against the illuminating power. Many gas engineers

were advocating the adoption of a new standard—calorific value instead of illuminating power; and from this point of view the paper was an opportune one. As had been said, Mr. Braidwood had not left them any room for discussion. He had certainly brought his subject up to date.

Mr. BRAIDWOOD thanked the members for the very cordial reception they had given his paper; and he most specially thanked Mr. Wilson, of Coatbridge, for his kind remarks. Mr. Cuthbert was of opinion that more accurate results were obtained with a Boys calorimeter than with other instruments. He (Mr. Braidwood) could not agree with this. He had had very large experience with the Boys calorimeter; and, in his opinion, it could not be compared with the Junkers for accuracy. He questioned whether it could be compared with the Simmance-Abady instrument. Mr. MacLaren spoke about the combustion chambers breaking. He had carried out a considerable number of tests with the calorimeter before them, and had not had many breakages. In the Rosenheim calorimeter, they put in an ordinary incandescent funnel in place of the bell-shaped one. He believed it was giving excellent results; but he had never worked with it. The President made some remarks about the tests which were being made at Provan for the purpose of trying to arrange a table that would show the comparison between the candle power and the calorific value of gas. He himself had been trying this for two years; and he had not arrived at any figure for a given candle power. In his opinion, the introduction of the calorific power standard in place of the candle power one must come. In works where a high candle power was maintained, lime had to be used to take out the carbonic acid; whereas if a calorific test were instituted in place of one for illuminating power, oxide of iron might be used, and the carbonic acid allowed to go forward—it being well known that this had not the same effect on the calorific value as on the illuminating power of gas. One per cent. of carbonic acid reduced the candle power of gas 3½ per cent.; while it only reduced the calorific value 1 per cent. Consequently, a considerable saving in the cost of purification would be effected if calorific value instead of illuminating power should be adopted as the standard.

The Last Examinations in "Coal-Tar Products."

In another part of the "JOURNAL" will be found a notice of the portion of the report on the work of the Department of Technology of the City and Guilds of London Institute for the session 1909-10 which deals with the last examinations in "Gas Engineering" and "Gas Supply." Readers are aware that examinations are also held in "Coal Tar Distillation and Products." The report shows that there were three centres where this subject was taught, and that 19 students attended the classes. There were, however, 24 candidates for examination, and 15 of them passed—2 first class in the Honours grade, and 8 first class and 5 second class in the Ordinary grade. The failures were 37·5 per cent. There were four prize winners, whose names were given in the "JOURNAL" for the 2nd of August last (p. 317). The Examiner in this subject (Dr. J. C. Cain), in his report, says that in the Ordinary grade the standard attained by the candidates was distinctly better than last year. The programme for the session 1910-11 was issued in June last; but the syllabus in "Coal-Tar Distillation and Products" could not be included, as it was under revision. It will therefore be issued separately.

The will of Mr. William Bishop, one of the Directors of the Stroud (Glos.) Gas Company, has been proved at £43,266, with a net personalty of £40,550.

At the meeting of the Graduates' Association of the Institution of Mechanical Engineers next Monday, Mr. J. C. Briggs, of Workington, will read a paper on "Requirements of Illumination and the Status of Gas Lighting." Mr. H. E. Jones will preside.

Alderman Abbey has just completed his jubilee as a member of the Brighton Corporation. He was elected in 1860, was chosen as an Alderman in 1867, and was Mayor in 1875. He rendered conspicuous service to the town in connection with the negotiations which resulted in the purchase of the undertaking of the Brighton, Hove, and Preston Water-Works Company in 1872.

Mr. J. M. Grundy, of the Borough Treasurer's Department, St. Helens, has been appointed Audit Clerk to the Aldershot Gas, Water, and District Lighting Company—a position advertised recently in the columns of the "JOURNAL," under No. 5317. Mr. F. J. Alban, the Deputy-Accountant to the Pontypridd District Council, was on Wednesday last appointed Accountant to the Pontypridd and Rhondda Joint Water Board. Mr. Alban was previously engaged under the Pontypridd Board of Guardians and the Llantrisant Rural District Council.

This month's arrangements for the London and Southern District Junior Gas Association (beyond the visit to the Fulham Gas-Works on Saturday, as noticed elsewhere) include a "coffee" meeting on the 16th inst., at 7 o'clock, when various questions sent in by members will be discussed, to be followed at 8 o'clock by an address by Mr. L. F. Tooth, of the Commercial Gas Company, entitled: "The Industrial Aspects of Gas." The Secretary (Mr. S. A. Carpenter) intimates that fifteen new members have just been elected—eleven from the staff of the Gaslight and Coke Company, two from the South Metropolitan Gas Company, and one each from the Commercial and Sevenoaks Gas Companies.

REGISTER OF PATENTS.

Combustion of Mixed Gases.

BONE, W. A., of Leeds University, WILSON, J. W., of Armley, near Leeds, and M'COURT, C. D., of Balham Hill, S.W.

No. 25,808; Nov. 9, 1909.

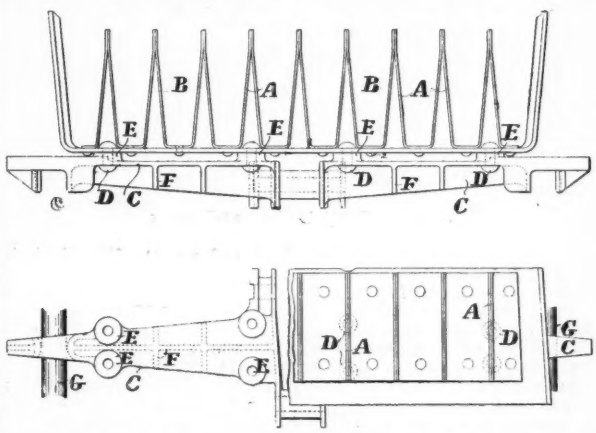
[See *ante*, p. 711.]

Carriers for Use in Apparatus for the Distillation of Coal.

RICHARDS, R. S., of Wraysbury, and PRINGLE, R. W., of Richmond, Surrey.

No. 22,421; Oct. 1, 1909.

This invention relates to carriers for use in the carbonization of coal, and is particularly applicable to endless conveyors used in the manufacture of partially distilled fuel, but "is applicable generally in cases where carbonaceous material is caused to travel on endless conveyors in or through flues or chambers where the material is subjected to heat." One of the patentees' specifications dealing with coal distillation was summarized last week, p. 650.



Richards and Pringle's Coal Carriers for Distillation Apparatus.

According to the present invention, the conveyor is composed of trays—preferably open-ended and of considerable width relatively to their length in the direction of travel. The trays are divided by longitudinal ribs into a transverse series of open-topped compartments for the material to be treated; and the ribs or dividing walls "may with advantage be so arranged as to form compartments of downwardly tapering section." The trays may be of sheet iron, and the dividing walls be formed of plates bent to channel shape, which may widen upwardly to provide downwardly tapering compartments. The dividing walls or plates are preferably arranged so as to provide rounded corners for the compartments. The trays are secured to an endless transporting device; and it is preferred to attach them one to each link of a chain passing round chain-wheels at the ends of the stretch. The links may be relatively narrow and lie below the middle line of the trays, and be formed with lateral arms or extensions for supporting the trays. The outer ends of the arms may run on rails, and may be sloped out to adapt themselves to the form of the rail or bearer so as to act as a guide.

With an arrangement described, the carbonaceous material fed into the trays falls into the several compartments, and "is thus subdivided into separate small charges by the dividing walls—thus securing more intimate application of the heat by conduction; the dividing walls themselves serving to store and transmit the heat to the contents of the tray compartments." The construction of the trays also allows of their travelling readily around the chain wheels or drums at the ends, and of conveniently discharging the material from the transverse compartments of the trays.

The patentees say they have found, from experiments, it is difficult to distil completely a greater depth than 2 inches of fuel on a travelling conveyor of ordinary construction; but by the use of their trays, they "are able efficiently to heat material disposed in the trays to a considerably greater depth."

The tray is formed (as shown) of a wide and relatively short container of sheet iron, of channel-like form, open at the top and ends. Inside the container are riveted a series of dividing walls A, of sheet iron bent to upwardly tapering channel shape; so as to subdivide the tray into a transverse series of tapering compartments B having rounded corners at the bottom. The tray extends at one end beyond the dividing walls, so as to overlap the end of the adjacent tray. The trays thus form a continuous conveyor. The trays are bolted to the links of an endless conveyor chain (one link of which is shown). The links are formed with lateral supporting arms C extending for about the width of the tray which is riveted to the supporting arms D—preferably as shown, so as to leave the forward end of the tray free of the link and arms. The arms are formed with bosses or projections E to provide bearing surfaces for the tray at the points of attachment, and with strengthening ribs F. Recesses at the outer ends of the arms fit over supporting rails G, on which the arms may travel. The links thus constructed are pinned together at the eyes so as to form the conveyor chain, which may run round chain wheels or drums as will be readily understood.

Combustion of Gaseous Fuel.

BONE, W. A., of Leeds University, WILSON, J. W., of Armley, near Leeds, and M'COURT, C. D., of Balham Hill, S.W.

No. 29,430; Dec. 16, 1909.

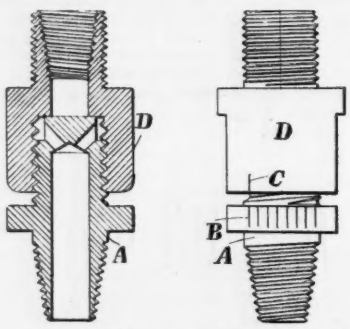
[See *ante*, p. 712.]

Regulating the Gas Supply to Burners.

PRESTON, J. N., of Glasgow.

No. 29,720; Dec. 20, 1909.

This device for regulating the gas supply to burners is of the kind in which an inner cap or nipple secured at its lower end to the gas-pipe is provided with an external cap or nipple adapted to be regulated by screwing one part on to the other; also there is an index mark on one part adapted to register with a scale on the other part to indicate the amount of gas passing in a given time, and not merely to show whether the valve is open or closed.



Preston's Regulator for Gas-Burners.

The governor consists of a nipple A and nut D. The nipple is screwed and tapered at its bottom, while its top is screwed and reduced slightly in diameter. It is axially bored to within a short distance of the top, and has two small holes bored radially through the side of the reduced part at its top at an angle. A scale B is cut upon part of its circumference for regulating the consumption; and for this purpose there is an index mark C on the outer cap D. Each scale mark would conveniently indicate a consumption of 1 cubic foot of gas per hour; and as there are seven marks, the device would register from 0 cubic foot to 7 cubic feet per hour. The consumption of gas is governed by unscrewing the nut, which is a tight fit, so that the part D cannot be moved without the aid of a suitable tool.

Incandescing Bodies for Gas Lighting.

UNRUH, MAX VON, of Charlottenburg, Berlin.

No. 30,148; Dec. 24, 1909.

The inventor's patent for the use of a mixture of oxide of thorium with organic fibrous materials, which are impregnated with lighting-salts—for instance, of thorium and cerium and with magnesium oxide and an organic binding substance—has already been described in the "JOURNAL" for April 6, 1909, p. 33. Experiments have since shown that a mixture of suitable organic and inorganic salts of thorium, cerium, erbium, zirconium, and thallium, or a mixture of the double salts of these elements, or mixtures of these salts and double salts, together with organic fibrous materials which are impregnated with lighting-salts, give better results than if oxide of thorium only is used, together with organic fibrous materials impregnated with salts.

The process of manufacturing the new mixture is as follows: The salts of thorium, cerium, erbium, zirconium, and thallium are thoroughly mixed (in any desired order) with organic fibrous materials, which are impregnated with lighting-salts; and, if desired, to this mixture an addition of suitable salts of magnesium, and, further, an addition of an organic binding substance may be made. The plastic material thus obtained is then either pressed into the form of the incandescent body, dried, and subjected to sufficient heat, or threads are pressed from the material, and the body is then formed from them in a suitable manner.

The process of preparing the organic fibrous substances which are impregnated with the lighting-salts, was described in patent No. 17,596 of 1908 (referred to above) and need not further be described.

Experiments have shown that the best organic binding substance preferably added to the mixture is a colloid, with an addition of suitable chemicals—such as sugar, glycerine, water, and the like. Sugar is a crystalloid; and therefore it cannot make a material plastic, while it is of importance for obtaining a certain rigidity and cohesion. Gelatine makes the material plastic and prevents the crystallizing of sugar. Glycerine increases the plasticity of the material; water is only used as a solving agent.

In the new process, salts of magnesium may optionally be used for obtaining rigidity and resistance of the incandescent body against shocks when red-hot; the salts of thorium and zirconium are used to prevent the shrinking of the body when subjected to sufficient heat to destroy the organic substances; the salts of erbium are used for obtaining a higher rigidity of the body; whereas thallium salts are used for obtaining a white light. The light of the other lighting-salts is reddish; while the green colour of the thallium salts acts as complimentary colour and makes the light white.

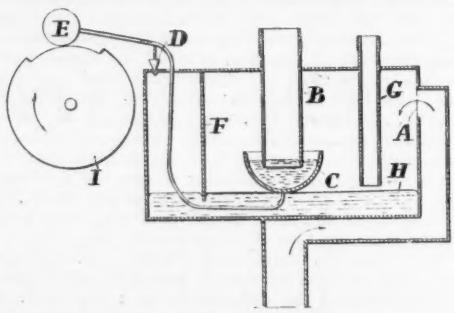
Incandescent bodies from the mixture can be made in different ways. For instance, fine threads can be laid vertically over a suitable mould or core, while a single long thread is laid almost horizontally round the core, whereby a reticular incandescent body is obtained, which is dried and subjected to heat. The incandescent bodies can also be made by pressing the material in suitable moulds in which an incision corresponds to every thread of the finished body.

Lighting and Extinguishing Apparatus for Gas-Burners.

MORAND, G. A. A., of Orléans, France.

No. 9202; April 15, 1910. Date claimed under International Convention, Nov. 5, 1909.

This apparatus, for automatically lighting and extinguishing gas-burners, consists of a cylindrical receptacle the upper part of which communicates, through the opening A, with the gas inlet pipe, and is provided (preferably in its central part) with a pipe B for the burner. A cup-shaped vessel C, filled with mercury, is arranged underneath the pipe B, being fixed on to the end of a lever pivotally mounted at D upon the wall of the receptacle. The outer arm of the lever is provided with a counterweight E, the weight of which is slightly greater than that of



Morand's Gas-Burner Lighter and Extinguisher.

the vessel C together with the mercury contained in it. The receptacle is divided into two compartments by a vertical partition F interrupted at its lower end, and is filled with mercury, so as to form a tight seal between the two compartments, thereby preventing the gas admitted into the right-hand compartment from escaping into the other one. A gas-pipe G, serving for the feeding of a bye-pass flame, comes to lie with its lower end at a small distance away from the level of the mercury H.

The lighting and extinguishing of the burner are effected at predetermined hours by a clock movement rotating a notched disc I or a cam arranged beneath the counterweight E. In the position illustrated, the counterweight has fallen into the notch formed in the disc, thereby raising the vessel C, and closing the lower opening of the pipe B by the mercury contained in the vessel. When the apparatus is in this position, the gas passing through the opening A into the right-hand compartment cannot reach the burner, but can feed the bye-pass flame owing to its free access to the pipe G.

The disc I rotates continuously in the direction of the arrow, and at the moment the notch at the top raises the counterweight, the vessel C descends and the mercury renders free the lower opening of the pipe B. The gas can now pass to the burner, and is lit by the bye-pass flame, which is at the same time extinguished by the cup-shaped vessel descending on to the mercury H, thereby causing the level of it to rise and close the opening of the pipe G. During the further rotation of the disc, the counterweight falls again into the notch, and causes the vessel C to rise and allow the mercury in it to close the passage of the gas to the burner, and the level of the mercury H to descend and allow the gas to flow into the bye-pass and be lit by the flame of the burner which is dying out.

Cooling Coal Gas.

BENNINGHOFF, O., and AUGUST KLÖNNE, of Dortmund, Germany.

No. 13,978; June 9, 1910.

This invention, relating to the cooling of coal gas, has for its object "to obviate the objectionable consequences resulting from the condensation of naphthalene," concerning which the patentees say: "In accordance with the treatment heretofore usual, the gas is first cooled in a gas-cooler having by day a temperature of from 60° to 70° C.; and it is then still saturated with naphthalene to an extent corresponding with its temperature—the naphthalene, however, separating out when the gas, during its further treatment, is passed through the system of pipes and is thus further cooled. Now, according to this invention, the condensation of the naphthalene in the pipes (heretofore inevitable) is prevented by again slightly heating the gas after it has been cooled to the ordinary atmospheric temperature, with the result that it enters the apparatus in which it is subsequently treated or utilized at a temperature somewhat above the lowest temperature to which it has been cooled in the gas-cooler. By the treatment in the cooler, the quantity of naphthalene contained in it has been decreased correspondingly with the fall in temperature; while by the subsequent heating, it is rendered possible to cool the gas in the intermediate pipes down to the coolest temperature prevailing in the gas-cooler without bringing about the condensation of naphthalene, which would only begin to take place if a still further fall of temperature occurred in the pipes. Should the gas now be led to various apparatus for further treatment, the precipitation of the naphthalene in the pipes themselves will be avoided. Care must, of course, be taken to prevent naphthalene from again becoming absorbed when the gas is reheated; and to this end the reheating of the gas is effected only as it leaves the cooler—reliability in the operation of the apparatus being thus secured."

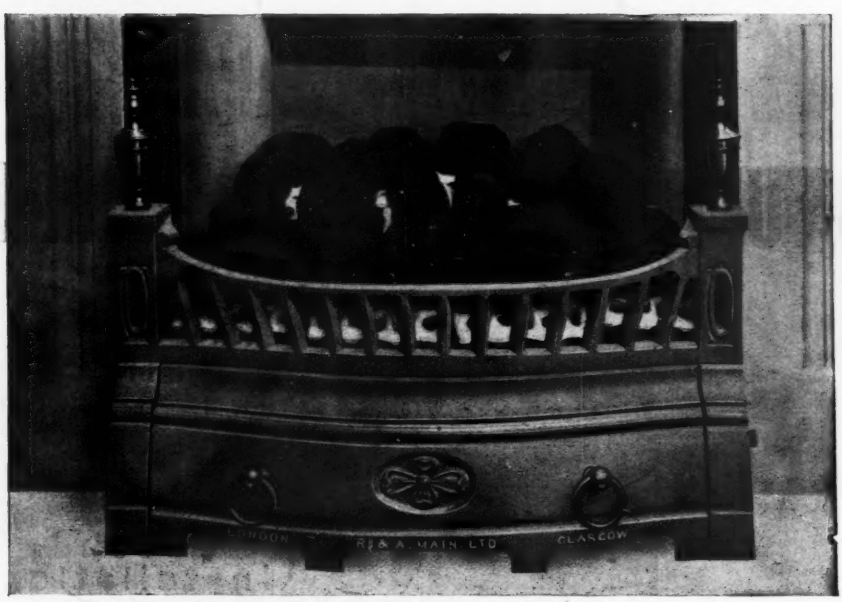
The apparatus for carrying out the process described is provided by

THE "MAIN" ISSUE.

The Referendum

may or may not be the best method of obtaining the "Will of the People."

Opinions Differ.



All are Agreed, However,

that the best method of converting a coal fire into a gas fire is by means of the

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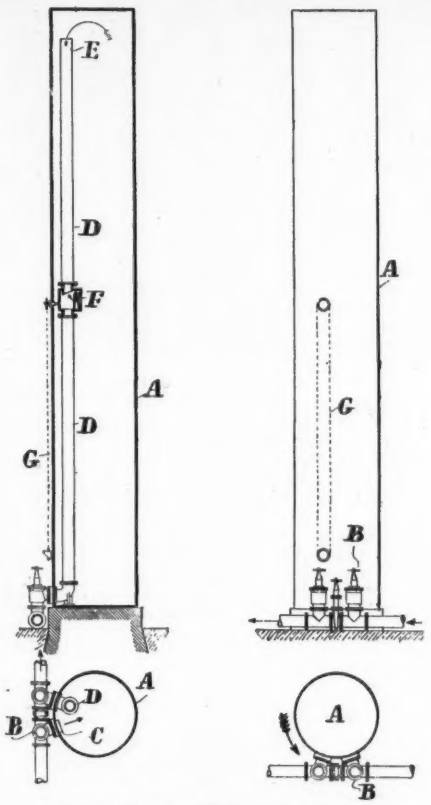
ENGINEERS,
MILES PLATTING, MANCHESTER.

arranging the outlet pipe of the gas-cooler within the interior of the cooler, and by so arranging it that the warm entering gases flow around it. As shown, the cooler consists of a cylinder A into which the gas enters at C through the valve B. The warm gas on entering flows around the outlet pipe D; and, as it passes through the cooler, it is cooled down to the ordinary atmospheric temperature. It then passes at E into the outlet pipe D, and is, during its passage through this pipe, again slightly heated by the gases entering at C, with the result that the outflowing gas is heated to an extent sufficient to prevent the



Benninghoff and Klonne's Gas Cooler.

condensation of naphthalene. At a suitable height there is provided in the outlet pipe D a valve F, which is actuated from the outside by controlling gear G, by means of which a portion (or, if necessary, the whole) of the gas in the cooler can be allowed to escape should the temperature within the cooler fall so low as to bring about excessive cooling of the gas. This valve may at the same time shut off the upper half of the pipe D; so that by the use of a single valve only half the cooling surface of the cooling chamber can be made use of when desired.

APPLICATIONS FOR LETTERS PATENT.

26,961.—Crawshaw, N. S., "Gas-regulators." Nov. 21.
27,024.—Mackay, J. F., and Leeson, G. W. T., "Adapters for burners." Nov. 21.
27,056.—Smith, C. C., "Indicating and recording the rate of flow of water." Nov. 21.
27,146.—Shaw, P. E., "Incandescent burners." Nov. 22.
27,154.—Bornong, M. P., "Igniting-tap for gas-burners." Nov. 22.
27,158.—Okey, P., "Gas-engine governors." Nov. 22.
27,228.—Goodwin, W. G., "Engine for the immediate production of power by steam and gaseous pressure." Nov. 23.
27,292.—Bour, E. F., "Gas-turbines." Nov. 23.
27,332.—Kent, W. G., and Hodgson, J. L., "Fluid meters." Nov. 24.
27,334.—Hodgkinson, T., "Artificial fuel." Nov. 24.
27,356.—Davey, W. R., "Preventing unauthorized persons from unscrewing or removing the unions from main cocks or gas services and meters." Nov. 24.
27,398.—Wilton, G., "Purification of coal gas and the manufacture of sulphate of ammonia." Nov. 24.
27,430.—Draper, R., and Tabberer, G., "Washing coke." Nov. 25.
27,450.—Farnham, R. V., "Gas-producers." Nov. 25.
27,469.—Safety Non-Explosive Reservoir Company, Limited, and Tempest, A. J., "Air-gas generator." Nov. 25.
27,478.—Bleichert, M. A., & M. P., "Quenching and removing coke." Nov. 25.
27,504.—Wilson, G., "Wet meters." Nov. 25.
27,525.—Hunt, W., "Exhauster or compressor for gases." Nov. 26.
27,545.—Knowles, A. E., "Gas analyzing apparatus." Nov. 26.
27,572.—Compagnie pour la Fabrication des Compteurs et Matérial d'Usines à Gaz, "Revolution counters." Nov. 26.

The Malta and Mediterranean Gas Company announce an interim dividend at the rate of 4 per cent. per annum (2s. per share) on the ordinary shares for the past half year.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Gas and Electric Lights in a Fog.

Sir,—A point of some considerable public importance was forcibly brought home to my mind last week (on Nov. 22), when driving home through the fog—namely, the marked difference between gas-lamps and electric lamps as aids to the fog-bound traveller.

Going along Piccadilly, the new gas-lamps made driving quite safe at a normal pace; but when we got past St. James's Street into the region of electric arc lamps—fairly numerous as they are along the Green Park—we were compelled to crawl, and only reached Knightsbridge (after repeatedly getting lost) by the aid of a link-man. Then we got into gas lighting again, and were able to progress at a steady rate of about seven miles an hour, although the fog was exceedingly dense along the side of the park.

It is quite evident that arc lamps up in the clouds are valueless for street lighting in foggy weather; and it is to be hoped that the new gas lighting now in use in St. James's Street and the neighbourhood will shortly be extended throughout the West-end.

Electric light has obvious advantages for many purposes, but none for street lighting; and, in the interests of public safety and convenience, it is to be hoped that this will be more clearly recognized in future.

Nov. 29, 1910. D. G.

Mr. Johns' Paper on Ammonia Recovery.

Sir,—My attention has been called to the figures given in the reply to the discussion on my paper recently read before the Midland Junior Gas Engineering Association; and I regret to find, on looking into the matter, that the figures given had reference to an exceptional period of working ten years ago, when heavy renewals had to be effected, and that the usual cost of sulphate making at Bath comes out at less than £3 per ton.

Birmingham, Dec. 3, 1910. W. H. Johns.

Dr. Colman's Lecture to the Southern Junior Association.

By an error in our last issue, we attributed to Mr. S. A. Bevington a set of questions asked of Dr. Harold G. Colman, at his lecture before the London and Southern Junior Gas Association on "Gaseous Combustion." We find they were handed in by Mr. T. F. Canning, the Senior Vice-President of the Association, and were as follows, and not as reported.

(1) In a retort-setting, is pressure conducive to more perfect combustion and a higher temperature?

(2) Taking two retort-settings, one with a greater number of transverse walls than the other, would the setting with the extra walls require more fuel to maintain a constant working temperature than the one with the lesser number of walls? If so, what becomes of the extra heat?

(3) Taking a water-circulator heated by a luminous gas-flame, or series of luminous gas-flames, what is the total amount of heat lost as light energy, and in apparatus of this kind can absence of carbon monoxide in the waste gases be relied upon to give conclusive proof of perfect combustion?

PARLIAMENTARY INTELLIGENCE.

GAS AND WATER PROVISIONAL ORDERS FOR 1910.

The Board of Trade have issued a report upon their proceedings under the Gas and Water Works Facilities Act, 1870, during the past session. It shows that last December twenty applications were made to the Board for Provisional Orders—fifteen relating to gas and five to water undertakings. The amount of capital proposed to be authorized was £359,941 by shares and £123,476 by loan—£289,941 share and £104,310 loan capital being for gas, and £70,000 share and £19,166 loan capital for water purposes. The Gas Orders related to Brownhills and District, Builth Wells, Burnham (Somerset), Chertsey, Cranleigh, Dinnington and District, Dunblane, Highbridge, Llanidloes, Pinner, Ripley, Rowley Regis and Blackheath, Sheffield, Sudbury and District, and Swansea; and the Water Orders to Barnstaple, Chelsham and Woldingham, East Kent District, South Kent, and Sutton District.

Gas Orders.

The principal objects of the applications in regard to gas were as follows: To empower the Ogley Hay and Brownhills Gas Company, Limited, to continue their existing works, construct and maintain further works, and manufacture, store, and supply gas in the urban district of Brownhills and the parish of Ogley Hay rural, in the county of Stafford. To authorize the Builth Gas and Coke Company, Limited, to maintain and continue gas-works, and manufacture and supply gas within the urban district of Builth Wells and the parishes of Llanddewir Cwm and Rhosferig, in the county of Brecknock, and the parish of Llanelwedd, in the county of Radnor. To empower the Burnham Gas Company, Limited, to maintain and continue existing gas-works, and manufacture and supply gas within the urban district of Burnham and parts of the parishes of Burnham Without, Brent Knoll, and Berrow, in the county of Somerset. To empower the Chertsey Gas Consumers' Company, Limited, to raise additional capital. To authorize the Cranleigh Gas and Coke Company, Limited, to construct and

maintain further works for the manufacture and storage of gas. To empower the Dinnington and District Gas Company, Limited, to maintain and continue existing gas-works, and manufacture and supply gas in certain parishes or townships in the West Riding of York. To empower the Dunblane Gas Company, Limited, to maintain and continue existing gas-works, construct and maintain further works, and manufacture, store, and supply gas in the parish of Dunblane, in the county of Perth. To empower the Highbridge Gas Company, Limited, to maintain and continue existing gas-works, and manufacture and supply gas in the urban district of Highbridge and parts of the parishes of Burnham Without and Huntspill, in the county of Somerset. To empower the Llanidloes Gas, Coal, and Coke Company, Limited, to maintain and continue existing gas-works, and manufacture and supply gas in the borough of Llanidloes and the parish of Llanidloes Without, in the county of Montgomery. To authorize the Pinner Gas Company, Limited, to raise additional capital. To empower the Ripley Water-Works and Gaslight and Coke Company, Limited, to maintain and continue existing gas-works, construct and maintain further works, and manufacture and supply gas in certain parts of the townships of Pentrich and Ripley, in the county of Derby. To extend the limits for the supply of gas by the Rowley Regis and Blackheath Gas Company. To make provision with respect to the quality of gas supplied by the Sheffield United Gaslight Company. To authorize the Sudbury Gas and Coke Company, Limited, to maintain and continue existing gas-works, and manufacture, store, and supply gas in the borough of Sudbury and the parishes of Great Cornard and Chilton, in the county of Suffolk. To extend the limits for the supply of gas by the Swansea Gaslight Company. Nine of the applications—viz., those coming from Brownhills, Builth Wells, Burnham, Dinnington, Dunblane, Highbridge, Llanidloes, Ripley, and Sudbury—were in respect of existing non-statutory undertakings. All the others had reference to undertakings authorized by Special Acts or Provisional Orders. The promoters of the Sudbury and District Gas Order withdrew their application shortly after it had been made.

There was no opposition to the Chertsey, Cranleigh, and Pinner applications; and the objections lodged in the cases of Builth Wells and Highbridge were withdrawn.

The objections made in respect of the Brownhills, Burnham, Dinnington, Llanidloes, Ripley, and Sheffield applications were fully considered by the Board of Trade. In the case of the Dunblane application, a local inquiry was held on behalf of the Board, and in each of the other cases, with the exception of Burnham, an inquiry was held at the office of the Board. In each instance they decided to grant the Order, subject to such modifications and amendments as were required.

The promoters of the Rowley Regis and Blackheath and the Swansea Orders failed to obtain the consents of some of the local and road authorities concerned, and requested the Board of Trade to exercise their powers under section 4 of the Gas and Water Works Facilities Act, 1870, and dispense with such consents. In the case of the former application, a local inquiry was held on behalf of the Board by Mr. Raymond Asquith, and as a result they decided to dispense with the consents of the Cakemore Parish Council and the Halesowen Rural District Council and grant the Order. In the case of the Swansea application, an inquiry was held at the office of the Board. It appeared that the local authorities had refused their consent except on certain conditions with regard to the price of gas in the added area of supply and the laying of additional mains; and the Glamorganshire County Council desired the insertion of a clause relating to the reinstatement of roads. The Board decided to dispense with the consent of the authorities concerned—viz., the Llansamlet Parish Council, the Clase and Cockett Rural Parish Councils, the Swansea Rural District Council, and the Glamorgan County Council—and grant the Order; allowing a maximum price for gas in the added area higher by 4d. per 1000 cubic feet than that charged within the borough of Swansea.

In the following Orders, a maximum price per 1000 cubic feet of gas was fixed: Brownhills, 4s. 6d.; Builth Wells, 5s. 6d.; Cranleigh, 4s. 6d.; and Llanidloes, 5s. 5d. A standard price with a sliding-scale as to dividends was fixed as follows: Burnham, 3s. 9d.; Dinnington, 4s.; Dunblane, 5s.; Highbridge, 3s. 9d.; and Ripley, 3s. 8d.

An illuminating power of 14 candles was prescribed in the Brownhills, Builth Wells, Burnham, Cranleigh, Dinnington, Dunblane, Highbridge, Llanidloes, and Ripley Orders; and of 15 candles in the Sheffield Order. The illuminating power previously prescribed in respect of the Cranleigh undertaking was 12 candles, and 16½ candles in respect of the Sheffield undertaking.

In the Builth Wells Order, power was given to the undertakers to grant a lease of the undertaking, subject to the approval of the Board of Trade. The Burnham and Highbridge Orders contain clauses relieving the undertakers from any obligation to supply gas to users of suction-gas plant, if and so long as, in the opinion of the undertakers, the giving of such a supply would interfere with, or jeopardize, the supply to other consumers. A clause was inserted in the Dinnington and District Order limiting the price for gas supplied for public lighting to 3s. 6d. per 1000 cubic feet. In the Sheffield Order, the undertakers were required, in consideration of the reduction allowed in the prescribed illuminating power of the gas, to supply new burners to consumers free of charge. The limits of the Brownhills and District Order included an area comprised within the statutory limits of the Lichfield Gas Company, which had not been supplied with gas by that Company. By agreement, a clause was inserted in the Confirming Bill, repealing the powers of the Lichfield Company in the area in question. Clauses were inserted, by agreement, in various Orders for the protection of road and other authorities.

Water Orders.

The principal objects of the applications for Water Orders were as follows: To extend the limits of supply of the Barnstaple Water Company. To empower the Chelsham and Woldingham Water-Works Company, Limited, to maintain and continue water-works, and supply water in the parishes of Chelsham and Woldingham and parts of the parishes of Oxted, Limpsfield, and Titsey, in the county of Surrey. To empower the East Kent District Water Company to extend their limits of supply. To authorize the South Kent Water Company to raise additional capital. To empower the Sutton District Water Company to extend their limits of supply, sanction and confirm the construction of their existing works, and authorize the construction of further works. With the exception of the Chelsham and Woldingham Order, which was in respect of an existing non-statutory concern, all the applications related to undertakings already authorized by Special Acts or Provisional Orders.

There was no opposition to the South Kent application; and the objection lodged in respect of the East Kent District application was withdrawn. A late objection was received from the Barnstaple Corporation with respect to the Barnstaple Order. The Corporation submitted a clause for their protection; but, in the absence of an agreement between the Corporation and the promoters, the Board of Trade did not insert it. Provisional Orders were granted in each of these cases, subject to such modifications and amendments as seemed necessary. The objections in respect to the Chelsham and Woldingham application were fully considered by the Board after an inquiry at their office; and it was decided to grant the Order, subject to certain modifications. In the case of the Sutton District Water Company's application, the promoters failed to obtain the consents of some of the local and road authorities concerned; and, an objection having been lodged by the Kingswood Water Company, Limited, an inquiry into the application was held at the office of the Board. Having regard to all the circumstances, they decided to dispense with the consents and grant the Order.

The limits of supply of the Chelsham and Woldingham Water Company included an area within the statutory limits of the Limpsfield and Oxted Water Company which had not been supplied with water by them. By agreement, a clause was inserted in the Confirming Bill repealing the powers of the Limpsfield Company in respect of the area in question.

Confirmation of Orders.

Bills to confirm the Orders granted by the Board were introduced as follows: In the House of Commons, the Water Provisional Order Bill, to confirm the Sutton Water Order.

In the House of Lords, the Gas Orders Confirmation (No. 1) Bill, to confirm the Brownhills, Builth Wells, Chertsey, Cranleigh, and Llanidloes Orders; the Gas Orders Confirmation (No. 2) Bill, to confirm the Burnham, Dinnington, Dunblane, Highbridge, and Pinner Orders; the Gas Orders Confirmation (No. 3) Bill, to confirm the Ripley, Rowley Regis and Blackheath, Sheffield, and Swansea Orders; and the Water Orders Confirmation Bill, to confirm the Barnstaple, Chelsham and Woldingham, East Kent District, and South Kent Orders. After the Gas Orders Confirmation (No. 2) Bill had been introduced, the promoters of the Dunblane Order informed the Board of Trade that they did not wish to proceed further; and the Board accordingly withdrew the Order when the Bill was in Committee of the House of Lords.

A petition was lodged in the House of Commons against the Water Provisional Order Bill by the Kingswood Water Company, Limited. The Company were promoting a Bill to authorize them to supply water in the parish of Kingswood, where they were already supplying without statutory powers. An application by the Company for a Provisional Order in the session of 1909 was opposed by the Sutton and District Water Company; and the Board of Trade refused to grant an Order. The Committee to whom the Bill and Provisional Order were referred decided to reject the Bill and pass the Order.

Petitions were lodged in the House of Lords against the Gas Orders Confirmation (No. 1) Bill, in respect of the Brownhills Order, by the Walsall Corporation and the Walsall Wood Colliery Company, Limited. The Corporation asked for the reinstatement of certain agreed provisions for their protection, which had been disallowed by the Board of Trade. The Committee decided to insert the clause in its original form; and an appeal clause for the protection of the colliery owners was also inserted. A petition was lodged in the House of Lords, by the Halesowen Rural District Council, against the Gas Orders Confirmation (No. 3) Bill, in respect of the Rowley Regis and Blackheath Order; but it was withdrawn. A petition was also lodged against the same Bill by the Butterley Company, Limited, in respect of the Ripley Order; and agreed clauses were inserted. The Swansea Order, which was included in the same Bill, was petitioned against by the Glamorganshire County Council, the Swansea Rural District Council, and the Great Western and other Railway Companies. Agreed clauses were inserted on behalf of the County Council and the Rural District Council. The petition of the Railway Companies was withdrawn; but it was again lodged in the House of Commons, and an agreed clause was inserted.

A petition was lodged in the House of Lords against the Water Orders Confirmation Bill, in respect of the Chelsham and Woldingham Order, by owners and occupiers of property in the parishes of Chelsham and Woldingham. Amendments were agreed to, and the petition was withdrawn.

With the foregoing exceptions, the Orders were unopposed; and all the Confirmation Bills received the Royal Assent on the 3rd of August.

Scotch Provisional Orders.

In addition to the Orders previously noticed, applications were made to the Secretary for Scotland, under the Private Legislation Procedure (Scotland) Act, 1899, for various powers in connection with gas and water supply. The Gas Orders have already been dealt with (*ante*, p. 249); and the Water Orders may be briefly noticed here.

The Clydebank and District Water Trustees have been authorized to construct additional works, consisting principally of the enlargement of their Burn Crooks reservoir, a catchwater or aqueduct, and a conduit or pipe-line, and to abandon certain works sanctioned by their Order of 1906. The new works are to be completed within seven years.

The Town Council of Fraserburgh have obtained an Order authorizing them to provide an additional water supply and construct and maintain new works, comprising an embankment for the purpose of raising and storing the waters of two confluent streams, a service reservoir in the parish of Strichen, and various conduits, a road diversion, &c., to be completed within five years.

The Kirkcaldy Corporation Order enacts that from and after Whit-

sunday, 1911, the limits for the compulsory supply of water, as defined by the Water Act of 1867 and extended by an Act passed in 1876, are to include such portions of the burgh as are not at present within these limits; and all the provisions of the Kirkcaldy and Dysart Water-Works Acts, 1867 to 1908, applicable to the present limits of compulsory supply are to apply to the extended area.

The Montrose Town Council have been empowered to maintain and continue their existing water-works and construct a number of others, comprising a storage reservoir and several aqueducts, conduits, or lines of pipes, which, with one exception, are to be completed within six years.

The Parliamentary Agents for the Clydebank and Montrose Orders were Messrs. Beveridge, Greig, and Co.; and for the Fraserburg Order, Mr. John Kennedy. The Town Clerk of Kirkcaldy (Mr. W. L. Macindoe) had charge of the Order relating to that town.

PROVISIONAL ORDER NOTICES (SESSION 1911).

The "London Gazette" last Tuesday contained the following additional notices of intended applications for Provisional Orders next session. They were published too late for inclusion in the list already given in the "JOURNAL."

Liverpool Corporation (Fazakerley) Gas.—Application will be made to the Local Government Board by the Liverpool Corporation for authority to adopt the "Metropolitan" No. 2 argand burner, or any other of which the Board or the Board of Trade may approve, as a standard burner, in substitution for the one now in use for the official testing of the illuminating power of gas supplied by the Corporation in the parish and township of Fazakerley. It is proposed that the Order shall define the conditions and method of testing with the new burner, and the regulations to be observed in order to correct the volume of gas consumed therein to the standard atmospheric pressure and temperature.

West Gloucestershire Water.—The West Gloucestershire Water Company will apply to the Board of Trade for authority to take, and for the Clutton Rural District Council, or any other company, body, or person within the district of the Council, or in any adjoining district, to give, a supply of water at such point or points as may be agreed upon, or as may be prescribed by the Order. The applicants will ask to have conferred upon them and the Council, and any other company, body, or person, all necessary powers for the distribution of water throughout the Company's limits, or such part or parts thereof as may be defined or prescribed; and also authority to enter into agreements.

Witney and District Gas.—The Witney and District Gas and Coke Company, Limited, will apply to the Board of Trade for authority to maintain and continue their existing gas-works, construct others, and manufacture and supply gas within the parish and urban district of Witney, and the parishes of Hailey, Minster Lovell, Curbridge, Cagges, and Ducklington, in the rural district of Witney, in the county of Oxford. The present capital is to be regulated, and authority to raise more will be applied for.

Standard Burner Bills Royal Assented.—Immediately before the delivery by the Lord Chancellor of His Majesty's Speech proroguing Parliament on Monday last week, the Royal Assent was given to a number of measures which had reached their final stage. Among them were the Dundee Gas Commissioners' Order Confirmation Bill and the three Gas Companies (Standard Burner) Bills.

Settlement of the Gas-Burner Question in Liverpool.

At the meeting of the Parliamentary Committee of the Liverpool Corporation last Wednesday (the first since the municipal elections), the Town Clerk reported that an interview had taken place between representatives of the Corporation and the Gas Company with respect to matters in dispute in connection with the alleged loss of candle power which consumers would suffer if the burner proposed in the Gas Companies (Standard Burner) Acts were adopted. It was stated that, as the outcome of the conference, a satisfactory settlement had been arrived at. [The matter was alluded to in the "JOURNAL" last week, p. 627.] At the same meeting, Alderman Bartlett was re-elected the Chairman of the Committee. In thanking the members, Alderman Bartlett said their sole business in the past year consisted in opposing the Gas-Burner Bills. This year, they were to have a Bill of their own. Whether it would be a contentious Bill or one that would go through without much difficulty, he did not know at present; but he would do his best to get Parliament to sanction any Bill which passed the City Council and the town's meeting.

Gas as a Mitigator of the Smoke Nuisance.—Writing in the "Manchester Guardian" last Tuesday, Dr. John Brown, of Bacup, dealt with the possibility of mitigating the nuisance of black fogs in the city. He said: "What is needed is joint action by all the towns within three to seven miles of Manchester having a conference. At present we can do much by smokeless coal, coalite, and cheap gas. Gas must be sold at prime cost. Manchester, in face of the evils of black fogs, cannot justify her present policy of making a profit out of gas. Liverpool has built, and is going to build, model dwellings. By these you concentrate on a limited area scores or hundreds of families, each with its domestic fire, with the result that the air within 200 yards in calm weather is heavily laden with soot and gases, so that the open window is neglected. In winter, the evils are greatly increased. All model dwellings in the future ought to be fitted up with domestic gas-ranges; and coal should be rarely, if ever, used. Gas should be sold at from 9d. to 1s. per 1000 cubic feet for cooking and heating purposes; and then to burn coal would be extravagant."

LEGAL INTELLIGENCE.

WATER SUPPLY TO FACTORIES.

HIGH COURT OF JUSTICE—KING'S BENCH DIVISION.

(*Before Justices* PHILLIMORE *and* COLERIDGE.)

Metropolitan Water Board v. Colley's Patent, Limited.

This was an appeal by the plaintiffs from the decision of his Honour Judge Woodfall, at the Westminster County Court,* that water supplied to factories was a "trade" purpose, and not a "domestic" supply. The action was brought to recover four quarters' water-rate in respect of defendants' factory in Marine Street, Bermondsey. The Board charged £21 4s. for a "domestic" supply of water; and defendants paid into Court £9 2s. 1d. for a "non-domestic" supply.

Mr. DANCKWERTS, K.C., and Mr. A. B. SHAW (instructed by Mr. W. Moon, the Solicitor to the Metropolitan Water Board) appeared for the appellants; Mr. C. A. RUSSELL, K.C., and Mr. C. A. M'CURDY (instructed by Messrs. Wells and Sons) represented respondents.

Mr. DANCKWERTS said the defendants' premises were supplied by one pipe, and they carried on the business of paper making and printing railway tickets—employing, on an average, about 50 hands. Water was used for, among other purposes, drinking, sanitary conveniences, and cleansing the premises. Prior to the coming into operation of the Board's Charges Act of 1907, the premises were supplied under contract, by meter for "trade" and "domestic" supply. In anticipation of the Act coming into operation, notice was given to determine the contract; and it came to an end at the time when the commencement of the supply now in question was given. As a matter of fact, since the termination of the contract, the parties had been unable to agree—the defendants having refused the combined contract which the Board were in a position to offer; and consequently the supply went on by meter. The present action was brought to recover the statutory rate of 5 per cent. on the rateable value of the premises under section 8 of the Act. The learned Judge decided that the Factory Act did not apply in the Metropolis, and that the case depended on certain sections of the Public Health Act, so that water supplied for drinking and other purposes came within the definition of a "trade" purpose.

Justice PHILLIMORE: That is in opposition to the decision of Mr. Justice Neville in the South Suburban Gas Company's case.

Mr. DANCKWERTS agreed that this was so. He said the Court of Appeal had decided that the London and Brighton Railway Company's case was distinguishable; the Master of the Rolls saying they must not be taken as approving or disapproving of the Gas Company's case, as it was not before them. His contention was that the County Court Judge should have followed the decision of Mr. Justice Neville, when the case could have been taken to the Appeal Court. Section 25 of the Charges Act defined the words "domestic purposes" as not including (among other things) water for a gas-engine or for any "trade, manufacture, or business." There were a series of decisions in which it had been held that the nature of the supply depended not on the character of the premises, but on the use to which they were put. [Counsel cited the cases of *South-West Suburban Water Company v. Guardians of the Poor of St. Marylebone*, *Chester Water-Works Company v. Chester Union*, *Frederick v. Bognor Water Company*, *South Suburban Gas Company v. Metropolitan Water Board*, all of which have been reported in the "JOURNAL."] The supply in the present case was clearly for "domestic" purposes; and Counsel submitted that on the decision of the Gas Company's case, the learned County Court Judge should have found for the Water Board.

Mr. SHAW said the Judge in the Court below had held that a supply of water to a factory could not be regarded as a "domestic" supply within the meaning of section 8 of the Charges Act; and this went beyond anything that had been brought before the Courts. If such a decision was right, all business premises in the Metropolis where only a caretaker resided would be entitled to be supplied by meter.

Mr. RUSSELL contended that the water was supplied for a manufacturing or business purpose. In order to arrive at what the purpose was for which the water was used, it was not enough to use general terms, such as "washing," "cleansing," and the like, but account must be taken of all the circumstances connected with the user of the water. In each case it was necessary to look at the ordinary habits of mankind, and their duties having regard to these habits. The contention on the part of the Water Board, if successful, would lead to a position of affairs never contemplated by the Act. By section 20, the Board had the right to insist on a supply by meter; and the present case was an attempt to put in their hands a power to supply either by that method or at the "domestic" rate, whichever paid them best. But the Act of Parliament did not give them any such right. The matter had to be looked at broadly; and it was for the Court to say whether the supply to these premises was one for trade or domestic purposes. His submission was that the only answer could be that it was for trade purposes, as the element of domesticity was entirely wanting.

Mr. SHAW having been heard in reply, judgment was reserved.

ACTION FOR DAMAGES FOR PERSONAL INJURIES.

In the King's Bench Division of the High Court of Justice, Mr. Justice Bray and a Common Jury had before them, last Thursday and Friday, the case of *Jones and Wife v. South Metropolitan Gas Company*. It was brought to recover damages for injuries sustained by the plaintiff, Annie Louisa Jones, by the alleged negligence of the defendants or their servants.

The plaintiff, Henry John Jones, is a postman, and on the 12th of January last was residing with his wife at 165, Rotherhithe New Road.

* See "JOURNAL," Vol. CXI., p. 402.

On that date the defendants were engaged in putting in a gas-meter, for which purpose they made in the hall of the premises a hole which it was said they left unlighted and unguarded, and of which they gave no warning to the plaintiff—thereby creating a trap in the hall. The female plaintiff fell into the hole, and received personal injuries, in consequence of which she had been caused considerable pain, and both plaintiffs had sustained damage and loss. The defendants denied that either they by themselves or their servants were guilty of negligence. They further denied that the female plaintiff had suffered the injuries alleged; and, alternatively, they pleaded that if she had sustained injury, it arose from her own negligence in not looking where she was going when walking along the passage, where the flooring had to her own knowledge been removed.

Mr. Norman Craig, K.C., and Mr. Douglas Hogg (instructed by Mr. Gilbert Robins) appeared for the plaintiffs; Mr. Shearman, K.C., and Mr. Ernest Charles (instructed by Messrs. Hicklin, Washington, and Pasmore) represented the defendants.

In the course of her cross-examination, Mrs. Jones denied that the workmen who made the hole warned her about it, and said it was never covered over as it should have been. When the accident occurred, the workman said: "I thought you knew the hole was there." The husband gave corroborative evidence, in the course of which he said a foreman of the Company called on him and told him he was always speaking to the men about leaving holes uncovered. He also said he wondered there were not more accidents than there were.

Evidence having been given on the other side, the Jury gave the plaintiffs £25 damages. Judgment was entered accordingly; stay of execution being refused.

LIABILITY FOR A DEFECTIVE STOPCOCK BOX.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Thursday, Nov. 24.

(*Before the* MASTER OF THE ROLLS *and Lords Justices* MOULTON *and* FARWELL.)

Rosenbaum v. Metropolitan Water Board.

This was an appeal by the defendants from the judgment of Mr. Justice Channell, who tried the action early in June last without a Jury, and awarded the plaintiff damages in respect of an injury sustained by her through falling by catching the heel of her shoe in a stopcock box in Oxford Street.*

Mr. C. A. RUSSELL, K.C. (with him Mr. A. B. SHAW), said the question raised by the appeal was whether there was any liability upon the Water Board to pay compensation in respect of an accident caused by tripping over a stopcock box. The box in question, which was fitted flush with the surface of the road (the hole being 2⅞ inches diameter), was put down by the Board under the power contained in section 28 of the Water-Works Clauses Act, 1847. In the case of the *East London Water Company v. St. Matthew, Bethnal Green*†, it was held that a box of this kind was included in the works authorized by the section cited. It was not contended for the plaintiff that the absence of a cover to the box was a matter of complaint. But it was said, on the authority of *Osborne v. Metropolitan Water Board*,‡ that it was the practice of the Board to put in the hole a wisp of straw known as a "wad;" and it was suggested that had there been an efficient wad, there would have been no ground of complaint, but that the wad was not efficient. His contention was that there was no evidence to show that the absence of the wad caused the accident; for a wad was not intended to afford protection to the public, but merely protect the apparatus from frost.

Lord Justice FARWELL pointed out that the Act cast upon the Water Board the duty of reinstatement; and if they left a hole 3 inches in diameter, surely they were guilty of breach of duty.

Lord Justice MOULTON said he was not sure that the right issue had been tried, which was whether or not there was a nuisance.

Mr. NORMAN CRAIG, K.C., for the respondent, said the whole argument in the Court below proceeded upon the assumption that a box without a cover might be used, so long as adequate steps were taken to prevent it being a nuisance. Evidence was given that about fourteen accidents had occurred from this particular box not having been efficiently covered. If there was no obligation on the Board to fill in the hole, so as to protect the public, what was the limit the other way? What was the size of hole which could be permitted?

The MASTER OF THE ROLLS: Your difficulty is greatly increased by your having relied on the judgment of Mr. Justice Phillimore in the Osborne case, which I have some difficulty in following.

Mr. NORMAN CRAIG said he had not relied upon this judgment.

Mr. RUSSELL: But Mr. Justice Channell did.

Mr. NORMAN CRAIG said the law, as laid down by the House of Lords, was that if the damage could be prevented by the reasonable exercise of defendants' powers, there was cause of action. Here the learned Judge had found as a fact that a hole with a proper wad was not dangerous.

As there appeared to be a difference of opinion as to the findings of fact, Lords Justices Moulton and Farwell went and saw Mr. Justice Channell. On their return,

Lord Justice MOULTON said Mr. Justice Channell did not decide the question of whether the hole was a danger without the straw. He thought that, by reason of defendants always having put the straw there, it was an admission that the hole was to be regarded as dangerous without it.

The MASTER OF THE ROLLS said it was difficult to come to the conclusion that there had been a distinct finding of fact upon the point; and under these circumstances it would be better that there should be a new trial.

Mr. RUSSELL contended that, upon the evidence before Mr. Justice Channell, the finding could not be upheld, and that he was entitled to judgment, as the case was deliberately fought upon the footing that, apart from the question of the wisp of straw, the hole was not a nuisance. If this admission had not been made, the defendants were prepared to give evidence to show that it was a proper box.

The MASTER OF THE ROLLS: We cannot decide it upon the evidence already given.

Lord Justice MOULTON: When you put a manhole cover in the road, it cannot possibly continue at the same level; and it may be described as a source of danger. There must be some more definite finding before we can apply the law to it.

The MASTER OF THE ROLLS said the Court could not satisfactorily deal with the case; and therefore it must go down for a new trial. He would suggest that, when it was again tried, neither party should rely too much upon the judgment of Mr. Justice Phillimore.

The order was then discharged; all costs to abide the result of the new trial.

* See "JOURNAL," Vol. CX., p. 706.
† *Ibid.*, Vol. XLVIII., p. 243. ‡ *Ibid.*, Vol. CIX., p. 444.

RECOVERY OF WATER-RATES FOR TENEMENTS.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Saturday, Nov. 26.

(*Before the* MASTER OF THE ROLLS *and Lords Justices* MOULTON *and* FARWELL.)

Metropolitan Water Board v. Brooks.

This was an appeal by plaintiffs from the judgment of Mr. Justice Channell in an action tried without a Jury for the recovery of water-rates from Midsummer, 1904, to Lady Day, 1908, on certain blocks of buildings in the East End of London.*

Mr. DANCKWERTS, K.C., and Mr. A. B. SHAW appeared for the appellants; Mr. C. A. RUSSELL, K.C., and Mr. GIVEEN represented the respondent.

Mr. SHAW, in opening the appeal, said the premises in question, which were erected in 1903 by one Davies, consisted of separate tenements under £20 in value; so that the owner, not the occupier, was liable for the water-rate. The supply was by meter at an agreed price of 1s. per 1000 gallons. Davies paid the rate down to Midsummer, 1904; but since that date nothing had been paid. The premises were mortgaged to the Norwich Union Insurance Company, who in 1906 appointed the respondent as receiver of rents; and the question was whether he was personally liable for the water-rate under the section which provided that in the case of small properties the person actually receiving the rent was deemed to be the person liable. Mr. Justice Channell decided that Brooks was not liable.

The MASTER OF THE ROLLS: A receiver does everything in the name of the mortgagor.

Mr. SHAW agreed that this was so; but he said the appellants relied on the special sections of the Act that in certain cases the person collecting the rent was liable. The occupiers paid a sum as rent which included water. It appeared from the evidence that the actual person who received the rent was one Smith; but he was merely the agent for the owner.

Mr. DANCKWERTS pointed out that under the Water-Works Clauses Act, 1847, upon non-payment of the rent, a water company were entitled to cut off the supply; and by section 72 the owner was made liable in the case of small properties. The Act of 1847 was incorporated in the East London Water Act of 1853; and as it was thought that a hardship might be inflicted on the occupiers, the Water Companies (Regulation of Powers) Act of 1887 was passed, which restrained companies from cutting off the supply in such cases, and the rent was made a charge upon the premises. His contention was that Brooks, and not Smith, answered the description of "owner" in the Act.

Monday, Nov. 28.

On the resumption of the hearing to-day,

Mr. DANCKWERTS read the judgment delivered in the Court below, and submitted that the learned Judge had come to a wrong conclusion, and that judgment should be entered for the appellants.

Counsel for the respondent were not called upon.

The MASTER OF THE ROLLS, having stated the nature of the appeal, said Mr. Justice Channell based his judgment upon the construction of section 4 of the Act of 1887. Without expressing any opinion in the least adverse to the learned Judge on this point, he thought the difficulty of the appellants began at a much earlier stage. By section 72 of the General Act of 1847, provision was made that in the case of small tenements the owners and not the occupiers were to be liable; and the section went on to say that the person receiving the rent from the occupier, either on his own account or as agent or receiver, should be deemed to be the owner of such house or tenement. Now, what were the facts in the present case? These small tenements belonged to Davies, who in 1907 appointed Smith to collect the rents; and when he was appointed, certain things happened. What was the position of things at that time? Smith was the man appointed by Davies as agent to collect the rents of these houses, and authority was given to him to relet any that might become empty. Therefore Smith was exactly the one person contemplated by section 72 of the Act of 1847. Then came the mortgage to the Norwich Union Insurance Company and the receivership deed. There was no suggestion of any fresh appointment by Brooks as receiver. All that appeared was that Smith continued to collect the rents as he had done before, with apparently such authority as he already had; and he handed them over to Davies, and afterwards to Brooks. He had nothing to do with the period during which Brooks entered into possession, in the sense that he turned out Smith. From first to last, Smith was the person who received the rents and profits from the occupiers as agent for the person interested; and Smith, and he only, was the person who could be sued. For these reasons, he thought Mr. Justice Channell was right in the conclusion at which he arrived. He might also say that he thought the decision was really in favour of the Water Board. The effect of

* See "JOURNAL," Vol. CIX., p. 880.

the section was this—that an agent of a receiver appointed to collect the rent had *prima facie* no right to do anything more than hand over the rent to his employer. But here the section said for "the benefit of the water company;" so that there was an express provision imposing an obligation upon the agent to pay the water-rate, and only to hand the balance to his employer. If this was the meaning of the section, it was very much in favour of the Water Board.

Lords Justices MOULTON and FARWELL concurred.

The appeal was accordingly dismissed, with costs.

COWDENBEATH GAS COMPANY'S SHARES IN DISPUTE.

Question as to the Right to Participate in an Issue.

In the "Notes from Scotland" in the "JOURNAL" for the 25th of October, reference was made to an action brought in the Court of Session by Mr. Alexander Waddell, of Dunfermline, and Mr. Forbes Waddell, of Queensferry, against Mr. James Hutton and Mr. G. B. Tweedie to recover the sum of £1010, in respect of shares in the Cowdenbeath Gas Company, Limited.

Messrs. Waddell and the defendant Hutton were all interested in the Company as shareholders; and the nature and extent of their respective rights were set forth in an agreement dated Nov. 14 and 19, 1903, and in a memorandum of variations dated Feb. 13 and 18, 1904. At the date of the agreement, the shares were allotted in the following proportions: To Messrs. Waddell, 611; to Mr. Hutton, 354; and to other parties, 57—making 1022. The plaintiffs had to borrow money in order to enable them to pay for the shares allotted to them; and the defendant Hutton, who was Chairman of the Company, became a creditor. On Oct. 14, 1905, a further issue of 178 shares was made; and these were all issued to Mr. Hutton and to nominees—bringing up their total holding to 532 shares, or 79 short of the number allotted to Messrs. Waddell. Of these, Mr. Forbes Waddell had sold 12; so that their holding was then 599 shares. On Dec. 3, 1906, a further issue of 300 shares was made; and it was in connection with this issue that the dispute had arisen. Plaintiffs averred that, according to the Company's Articles of Association, the shares were in the first instance offered to the then members of the Company in proportion to the existing shares held by them, and in particular that there were offered to the defendant Hutton 283 shares; this being in proportion to the number of which he and his nominees were the registered proprietors. These shares included the 599 truly belonging to the plaintiffs, but standing in Mr. Hutton's name. The number which, under article 10 of the agreement, he required to take up in order to equalize the holding of himself and his nominees with the original holding of the plaintiffs was 79. Deducting these shares from the 283 offered to him, there remained 204; and these, according to the plaintiffs, had to be offered in the proportion of 103 shares to Mr. Hutton and his nominees and 101 to them. Mr. Hutton declined to take up more than the 79 shares required to bring his holding up to 611, and did so without consulting the plaintiffs as to whether or not they wished to take up the shares to which they were entitled, and without informing them of the intended issue; and they averred that they had sustained loss in consequence. The value of the shares was at least £20 for each fully-paid share of £10; and the plaintiffs could have disposed of their allotment rights at a premium of £10 a share.

The question before the Court was whether Mr. Hutton—the 599 shares being registered in his name, though he really held them only as security for a debt—was under any obligation to notify to the plaintiffs that an allotment of new shares had been offered to him in respect of these shares. It was argued that, as security holder, he was not bound to take any steps towards furthering his debtors' interests, and that there was no duty upon him to take up the shares. Lord Armidale, in giving judgment, said there was much force in this contention; but, on the other hand, a creditor must have some regard to the interest of his debtor. As he read the agreement, he thought it was certainly an implied term of it that, as between the defendant Hutton and the plaintiffs, the latter were to be treated as continuing shareholders of the Company; and that the possibility of new shares being offered to them was within the contemplation of the parties. If it was incumbent on the defendant Hutton to give notice to plaintiffs of the offer of new shares, as he (his Lordship) considered it was, he further thought that Hutton would have been bound to take such steps as would have been necessary to make the allotment available, subject always to his own security not being in any way affected thereby. It seemed to him, therefore, that Hutton was liable to account for any damage that was occasioned to the plaintiffs by his failure to make them aware of the allotment in question. He should accordingly allow them a proof, so far as their action was directed against Hutton. With regard to the defendant Tweedie (who was the Law Agent of the Company), he thought there were no averments relevant to support the conclusion of the summons directed against him; and he should accordingly dismiss the action, so far as he was concerned, with expenses.

On Saturday last, a reclaiming note for Mr. Hutton was lodged with the First Division of the Court; so that the decision of Lord Ormidale will be brought under review.

QUESTION AS TO A WATER-SUPPLY AGREEMENT.

At the last sitting of the Truro County Court, his Honour Judge Granger heard a case in which the Truro Rural District Council sued Lord Falmouth for the recovery of £1 6s. 3d., as water-rate for two houses in the parish of St. Agnes. Mr. Coulter Hancock, for the plaintiffs, explained that, at the request of the Local Government Board, the District Council provided a supply of water for part of the parish of St. Agnes; and this parish being a "contributory place" within the meaning of the Public Health Acts, the cost of the scheme had to be charged to a special expenses account. Under the Public Health Act, 1875, the owner or occupier of a dwelling-house within 200 yards of a stand-pipe provided by the rural authority was liable to pay a water-rate. In the present case, Lord Falmouth disputed his liability; and the action was brought in order that the point might be decided. His Lordship met the Council in every possible way in connection with the supply, and the action was of a friendly nature.

Mr. W. S. Sitwell, who appeared for the defendant, said that when the water supply was provided Lord Falmouth granted a lease, under which the Council had obtained certain land whereon a reservoir and pumping-station had been constructed, and also the water rights and other privileges. The lease contained covenants relating to the supply of water to Lord Falmouth; and his contention was that his Lordship's tenants were to have a supply from the stand-pipes, subject to the terms of the declaration in the lease. Lord Falmouth conveyed to the Council the whole of the water supply which was the supply of his tenants. Mr. Hancock, who appeared for the Council, argued that if the clause in the lease on which Mr. Sitwell relied meant anything, it was *ultra vires* and inoperative.

His Honour said it was perfectly clear that when the lease was entered into there was a limiting of the plaintiffs' power to make a special rate, and that by the declaration they were prohibited from obeying the Statute. The Council had no right to enter into an agreement by which they were prohibited from fulfilling the Statute of 1875. The declaration was *ultra vires*, and judgment must therefore be given for the Council.

GAS COMPANIES AND INCOME-TAX.

Scotch Company Obtains Depreciation Allowance.

The appeal of the Bo'ness Gaslight Company, Limited, for allowance in respect of depreciation, was heard on Nov. 30 before the District Commissioners at Linlithgow. The Company were represented by Mr. David Ballantine, Solicitor, of 205, Hope Street, Glasgow.

In this case, depreciation had been allowed in former years; and it had now been disallowed by the Surveyor, acting on instructions from the Board of Inland Revenue to abandon the depreciation system in assessing gas companies, and allow them renewals of plant instead. Mr. Ballantine contended that the method which the Board of Inland Revenue wished to be adopted was wrong in point of law, as being entirely contrary to the provisions of section 12 of the Customs and Inland Revenue Act, 1878, and of section 26 of the Finance Act, 1907; and he informed the Commissioners that if they did not see their way to conform to the provisions of these sections, and allow the deduction for wear and tear, the Company would be obliged to ask them to state a case for the opinion of the Court on the matter.

After hearing all the arguments, the Commissioners sustained the appeal, and decided to allow depreciation at the rates fixed by them on June 7, 1904, in a former appeal by the same Company on the question of depreciation. The rates then fixed, and again allowed, were 2½ per cent. on the written-down value of the holder, and 4 per cent. on the written-down value of all the other plant and machinery.

Claim for a Gas-Saving Apparatus.

At the Wandsworth County Court on Wednesday, before his Honour Judge Harrington, Messrs. W. Tice and Co., of Union Street, S.E., claimed from Mr. Walter John Sawyer, of the Cedars Laundry, Putney, £6 10s. for a patent gas-saving apparatus, which, it was said, had been successfully fitted in several Government Departments, including the War Office and the Admiralty. Plaintiffs' case was that the apparatus was fixed at the defendant's laundry on the understanding that if at the end of three months his gas bill showed a saving of 15 per cent. he should buy it. When, after six months had passed, plaintiffs applied for payment, defendant asked for the apparatus to be removed, alleging that it was a failure. Defendant, in evidence, said the apparatus so reduced the pressure of gas that there was trouble in starting the engine. It did not effect a saving of gas, and there was such a dangerous leakage from it that he put it out of action. Judgment was given for the plaintiffs for the amount claimed.

In the report of the case Painter *v.* Petersfield and Selsey Gas Company, Limited, in the last issue of the "JOURNAL," Mr. T. Webb, the Vice-Chairman of the Sunbury Gas Consumers' Company, Limited, who was one of the witnesses, was described as the "Manager of the Sunbury Gas-Works." This was incorrect. In his evidence, Mr. Webb stated that he was the Managing-Director, not the Manager, of the Sunbury Gas Company.

New Joint-Stock Companies Registered.—Among recent registrations of joint stock companies, may be noticed the following: British Lamp Manufacturers, Limited, with a capital of £2000 in £1 shares; offices, 40, Page Street, Westminster, S.W. Matchless Self-Lighting Syndicate, Limited, with a capital of £5000 in £1 shares; offices, 6, St. Swithin's Lane, E.C. Combination Gas-Steam Engine Syndicate, Limited, was registered on the 30th ult., with a capital of £500 in 1s. shares; offices, 9-15, Oxford Street, W.

Gas Exhibition at Theale.—A successful gas exhibition, under the auspices of the Theale Gaslight and Coke Company, Limited, was held at the Parish Room on Wednesday and Thursday last. Different types of appliances for heating and cooking were shown; many of the stoves, cookers, and radiators being in operation. A great variety of brackets and burners of the latest type were on view; and the room was brilliantly illuminated in the evening by inverted incandescent lights. In the afternoon and evening of each day, Mrs. Godfrey Sutcliffe gave lectures on cooking.

MISCELLANEOUS NEWS.

BELFAST GAS-WORKS EXTENSIONS.

A Meeting of the Belfast County Borough Council in committee was held last Wednesday, for the purpose of considering the recommendations of the Gas Committee with regard to extending the present gas-works.

Mr. J. A. DORAN, the Chairman of the Gas Committee, in moving the adoption of the minutes of the Committee relating to the matter, outlined the steps that had been taken, and drew attention to the main features of the scheme. The minutes, of course, recommended the adoption of the report of the Manager (Mr. J. Dunlop Smith), which appeared in the "JOURNAL" last Tuesday (p. 632), and which comprises a scheme for the re-arrangement of part of the existing works, and their extension on the site of the old abattoir.

Mr. EDWIN SQUIRE moved an amendment that was identical with one which had been defeated on a previous occasion. It was as follows: "That having considered the proposal of the Manager for an extension of the gas-works, while we largely agree with the lines upon which his suggestions are framed, provided it be necessary to maintain the works upon the present ground, we are, however, of opinion that the site proposed does not allow enough room for economical working or possible technical development, while it allows no room whatever for further extension; and we also consider that eighteen years is too short a period to arrange for when providing a site for requirements of such magnitude, especially taking into account the large amount of money now proposed to be expended. We therefore recommend the Council to authorize the Gas Committee to secure a larger site, where the coal can be delivered direct from the ship to the works, and, if possible, to arrange with the Harbour Commissioners to again negotiate for a portion of their ground."

After considerable discussion, the amendment was put to the meeting, and defeated; 12 voting for it, and 28 against. The minutes of the Gas Committee were then adopted.

The subject came before the full Council at their Monthly Meeting next day—the LORD MAYOR (Mr. R. J. M'Mordie) in the chair.

Mr. DORAN, in moving the adoption of the minutes of the Council in committee, said he wished to call attention to several points in the able scheme submitted by the Gas Manager. He could assure the Council that the matter of extensions had received very close and careful attention by Mr. Smith since he took charge of the works; and the result of his investigations was that very little could be done in the way of expansion unless portions of the present plant were brought up to date. After allowing for reserve, he found that their highest possible make of gas, when utilizing every available retort, would amount to 12,870,000 cubic feet per day; or if they left out the retort-house under injunction, 10,925,000 cubic feet. Last year their maximum day's make was 11,772,000 cubic feet; and the greatest output per 24 hours was 12,608,000. From these figures it would readily be seen how urgent the necessity was for immediately dealing with the matter of extensions, as if any serious breakdown occurred, they might at any time be placed in a most serious position. The question of the percentage of water gas to be used had long been a very vexed one, not only in Belfast, but all over the country. In Belfast, they had been using during the winter months as much as 50 per cent.; and as the Gas Committee were anxious to reduce this amount, instructions were given to Mr. Smith, when dealing with extensions, to so arrange that at no time would more than 25 per cent. of water gas be sent out. This wish of the Committee had been given effect to in the report submitted; but, of course, it would be impossible to do anything until some of the new plant had been erected. Another important matter was the cost. It was estimated that the total expenditure, as outlined in the plan, would be £600,000. It must, however, be borne in mind that the work would be undertaken in sections; and the first or heaviest portion would take about five or six years to complete, at a cost of £250,000, or £50,000 per annum. They would, of course, continue to use the present plant until this section was completed; and by that time the old machinery would be worked out, and would require renewal in any case. The saving due to improved results from the new plant would be more than sufficient to meet the interest and sinking fund payments on their capital expenditure. The balance of the money would probably not be wanted for many years, and only when the demand for gas necessitated it. Even should all the £600,000 be charged to capital account, their capital per million cubic feet of gas made would be as low as that of any other large gas undertaking in the United Kingdom. Probably the most urgent matter was to provide a new 10 million cubic feet gasholder and tank. Had it not been for the use of their water-gas plant, this must have been erected long ago, and they would not now have to pay for it. Their total storage was just over 6 million cubic feet, which was totally inadequate for such large works as theirs. The advantages to be derived from adopting the proposals made by the Manager were so obvious, that he did not think it necessary for him to go more fully into the matter. He trusted the members would confirm the decision arrived at on Wednesday by the Council in committee, and he was sure the results would justify their action.

Alderman CRAIG seconded the motion.

Mr. SQUIRE said he objected to the passing of the minutes, and wished to move an amendment. [This was in the same terms as the one given above, but with the omission of the clause referring to the Harbour Commissioners.]

The LORD MAYOR said he did not consider the amendment in order. He thought, after all the discussion that had taken place, it would be better to have a vote for or against the motion.

Mr. SQUIRE said he would accept this ruling. This, he supposed, was the last act of the drama; and it was only a sense of public duty that induced him to rise on this occasion. He had tried to find out from his constituents what their opinions on the subject were; and he was perfectly certain that in his action he had a large number of them at his back. No reason had been given for going to the centre of the city and leaving the site they formerly selected for the gas-works.

Mr. DORAN said it was to save half-a-million of money.

Mr. SQUIRE said his first argument against the present works was that the space was too limited. They were reducing the output of water gas and increasing the quantity of coal gas, with the result that their make of coke would be doubled—reaching very soon 100,000 tons per year. They could not deal with all the coke with the space at their disposal. Not only was the space limited, but, according to the Gas Manager, the reconstructed works would only provide for their requirements for a period of eighteen years. This was not satisfactory. He did not wish to go into the question of scrapping. There was not a single thing that might be scrapped to which he objected; he was willing to scrap everything that did not pay. Neither did he object to the spending of £600,000 on additional works. What he contended was that the money should not be spent on works in the heart of the city. The Manager had told them himself that he had never been asked to report on any other site. He (Mr. Squire) asserted that they could put up the same works on another site for the same money as was now proposed to be spent. It was said that within thirty years they would have paid back all the borrowed money. He believed they would. But during these thirty years, if they had the works on a water site, whereby they could take the coal direct from the ships, they would save on an average £4000 a year, and at the end of the time have a saving of about £10,000 a year. At great expense, they had brought over experts to guide and advise them; and these gentlemen, as well as their responsible officials, told them that the Twin Islands was the proper place to go to. In the teeth of this advice, the Council now went back on their previous decision, and overthrew everything they had done.

Mr. WORKMAN said, as he had intended to second the amendment, he should like to make a few remarks. He pointed out that it had been most strongly impressed upon them by experts and their own officials that they should have at least 2 acres per million cubic feet of gas; and 2½ acres was not considered out of the way. It was felt that they could not have too much room. It was now proposed, however, to do a thing which none of them had thought of up till now; for the Manager proposed to make a million cubic feet of gas on three-quarters of an acre. They should move very cautiously in this matter They did not know what the future might bring forth in the way of light, and how advantageous it might be to them to have plenty of room; and he submitted that all the space that could possibly be wanted could be had at the Twin Islands.

After some further speeches for and against the motion, it was put to the meeting and carried. A poll was then demanded, which resulted as follows: For the motion, 32; against it, 12—majority, 20 (one member of the Council not voting).

LISBURN GAS-WORKS PURCHASE.

Settlement of the Price.

It will probably be remembered that in the spring of this year an arbitration was held in London to determine the price to be paid by the Lisburn Urban District Council for the undertaking of the Lisburn Gas Company, Limited. The Arbitrators were Mr. Corbet Woodall for the Company, and Mr. H. E. Jones for the Council; the Umpire being Mr. A. J. Ram, K.C. In his award, which was published in the "JOURNAL" for the 9th of August (p. 415), he gave two prices, dependent upon whether the Company was decided to be a statutory or a non-statutory one. The award was stated in the form of a special case, which came before the King's Bench Division of the High Court of Justice of Ireland on the 22nd ult.

It was contended before the Umpire, on behalf of the District Council, that, though at the date of the notice to treat the Company's undertaking was non-statutory, and not subject to any legal restriction as to the amount of profit which could be divided, the Umpire and Arbitrators were bound to take into account the likelihood that the Company, if it had continued to exist, would have become a statutory Company, and to use their own judgment as to when that time would have arisen, and what restrictions, according to the practice of Parliament, would have been imposed. It was further contended on behalf of the Council that, in fixing the purchase price, the maintainable profit as from that time should be taken at a sum not exceeding that which under statutory restrictions the shareholders would have been allowed to divide. For the Gas Company, the contention was put forward that the Umpire ought not to have regard to the considerations mentioned, but that in ascertaining the sum to be paid by the Council to them he must regard the maintainable profits of the Company existing as a non-statutory one. If the Court should be of opinion that the contentions put forward for the Council were correct, and that they ought to be taken into consideration, then the Umpire awarded that the sum of £31,445 should be paid to the Company; if, on the other hand, the contentions put forward for the Company were correct, he awarded £34,227 as the purchase price.

The case had been partly stated by Mr. Ronan, K.C., for the District Council when the Court adjourned, and the matter remained in abeyance. It was, however, in the list to be mentioned last Wednesday, when a consent was handed in, and made a rule of Court, bringing the questions in dispute to a satisfactory settlement. It provided that the purchase price should be £33,000, possession to be taken by the Council, together with all existing contracts for the supply of gas material and other stores. It was further provided that the Council should take over the Company's employees under their existing engagements.

The *agenda* for the December meeting of the Manchester City Council includes two notices of motion relating to the quantity of gas supplied for 1d. to prepayment-meter users. Both Mr. Jennison and Mr. Hailwood ask for greater consideration to "penny-in-the-slot" consumers of gas.

GENEVA MUNICIPAL GAS SUPPLY.

Report and Accounts for 1909.

The number of the "Journal des Usines à Gaz" for the 20th ult. contained the official report on the working of the gas undertaking of the Geneva Municipality in the year ended Dec. 31 last. It furnishes the following particulars.

The past year, it may be remembered, was marked by the terrible explosion which occurred on the 23rd of August. It is not considered necessary to give any details of this catastrophe in the report; all that is said about it being that the repair of the damage to the plant and the reconstruction of the buildings occupied the officials up till the end of the year. The restoration of the gasholder to its proper working condition was a troublesome job; and it was not finished till early in February last. In the first months of the present year, the completion of the repairs was effected. The stoppage of the furnaces for seventeen days after the accident did them some injury; and it is considered that their working life will be somewhat shortened in consequence. A project for the construction of an installation of vertical retorts and the erection of new coal-stores, the consideration of which was interfered with by the explosion, has been again brought forward with the view of some definite action being taken to carry it into effect, as the present productive power of the works is altogether inadequate. A sum of 141,000 frs. (£5640) voted by the Municipality in March allowed of various extensions being made to the buildings and plant.

The total production of gas last year was 11,049,110 cubic metres, or 390,033,590 cubic feet; the total consumption being 11,046,660 cubic metres, or 389,947,090 cubic feet—a difference of only 2450 metres, or about 86,500 cubic feet. Of the total make, 1,454,450 cubic metres, or 13·16 per cent., was carburetted water gas. The quantity of coal carbonized was 29,931,870 kilos., or 2,653,670 kilos. less than in 1908. The average price delivered on the works was 34 frs. 66 c. per ton, against 35 frs. 15 c. before. The average yield per 100 kilos. (220 lbs.) was about 70 cubic feet more than in 1908. For making water gas, 625,645 kilos. of oil and 935,000 kilos. of large coke were used. The oil cost 9 frs. 67 c. per 100 kilos. delivered on the works, compared with 10 frs. 70 c. before. The average charge of coal per retort per day was 682 kilos.; the average production, 252 cubic metres (8900 feet).

Turning to the statistics relating to the residual products, we find that the quantity of coke produced was 24,011,050 kilos., or 80·22 per cent. of the coal carbonized. Of the entire bulk, 16,373,800 kilos. were sold or used in the municipal buildings, and 7,637,250 kilos. utilized on the works. The proportion of coke used for heating the furnaces was 18·25 per cent. of the coal carbonized; the coke sold representing 68·19 per cent. of the total production and 54·70 per cent. of the coal carbonized. There were produced 1,566,014 kilos. of tar, or 5·23 per cent. of the coal. A large quantity of it was sold for use on roads. The greater portion of the tar resulting from the manufacture of water gas was mixed with the ordinary coal tar. The pitch, which is very difficult to sell, was used in a crude condition in the horizontal retorts. The production of ammoniacal liquor was 260,080 kilos.; its ammonia content being 21·6 per cent., or equal to 56,180 kilos. of ammonia. The concentrated liquor constituted 0·87 per cent. of the coal carbonized. The yield of ammonia was 0·188 kilo. per 100 kilos. of coal.

As already stated, the total consumption of gas—or rather the total quantity sent from the works—was 11,046,660 cubic metres. It was disposed of as follows:—

	Cubic Metres.		Per Cent.
Consumption by meter	9,125,407	..	82·61
,, by fixed burners (court-yard and stair lighting)	430,498	..	3·90
,, for public lighting	804,664	..	7·28
Used on works, in offices, &c.	126,858	..	1·15
Unaccounted for	559,233	..	5·06
Total	11,046,660	..	100·00

The quantity of gas sold was the total of the first three items—*i.e.*, 10,360,569 cubic metres. The population served being 113,079, the total output was equal to 97·7 cubic metres, or about 3450 cubic feet, per head. The unaccounted-for gas, as shown above, was 5·06 per cent., compared with 3·69 per cent. in 1908. There were at the close of the year 28,054 consumers by meter; and they burnt 325·2 cubic metres, or about 11,480 cubic feet, each. In 1908, there were 26,748 consumers; and they used 346·5 cubic metres, or 12,232 cubic feet, per head. The total length of mains at the close of the year was 238,137 metres, or nearly 262,000 yards.

The number of meters on hire at the close of last year was 27,889; the total number fixed being 28,688, representing 202,586 burners. They were divided as follows: Wet, 18,159; "Duplex," 8280; dry, 2242; prepayment, 7. The number of cooking and heating appliances sold during the year was 1919; bringing up the total sold in the past ten years to 14,304. Since 1892, the year in which installations were first made on account of the Municipality, the number of cooking and heating stoves sold by their agents has been 30,778; and since 1886, when cooking-stoves were first fixed gratuitously, the number sold has been 37,719. There were 16 gas-engines at work last year, or three more than in 1908. The number of public lamps in use on Dec. 31, 1909, was 2832, or 69 more than at the close of 1908. The total includes 197 lanterns with two burners, nine with three, and one with four. With few exceptions, all the lamps have incandescent burners, and 15,844 mantles and 3929 chimneys were used in connection with them last year—an average of 5·6 mantles and 1·3 chimneys per burner.

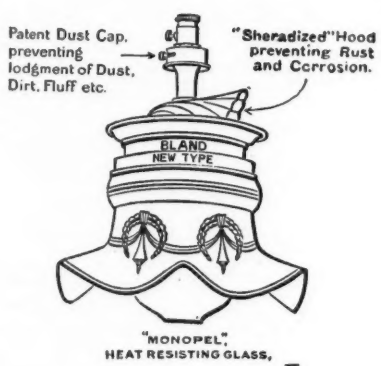
Coming to the portion of the report dealing with finances, we find that the sale of gas produced 2,080,558 frs. (£83,222), or 32,548 frs. (£1302) less than in 1908. The sale of gas for public lighting yielded 115,980 frs. (£4640), or 389 frs. (£15) more than before. The revenue derived from the sale of residuals and from other sources than the supply of gas amounted to 592,723 frs. (£23,709). The total working

Phenomenal Success

OF

The BLAND NEW TYPE BURNERS.

(FULLY PATENTED.)


Patent Dust Cap, preventing lodgment of Dust, Dirt, Fluff etc.
"Sheradized" Hood preventing Rust and Corrosion.
BLAND
NEW TYPE
"MONOPEL" HEAT RESISTING GLASS.

BRITISH MADE THROUGHOUT.

110, Cannon Street, E.C.

"We have pleasure in stating that we have examined the Books of your Company, and find that the Sales of the **NEW TYPE** Bland Burners for this Season **GREATLY EXCEED** the Sales for the corresponding period of last year."

(Signed) TINGLE, COMBER & Co.,
Chartered Accountants.

The Bland Light Syndicate, Ltd.,
London and Manchester.

expenses for the year, less the above-named sum, came to 1,245,075 frs. (£49,803); being at the rate of 12·017 c. per cubic metre of gas sold. Adding 5·5 per cent. on the outstanding capital, 4·876 c., makes 16·893 c. per cubic metre, or about 3s. 9½d. per 1000 cubic feet, compared with 16·237 c. per cubic metre, or 3s. 7¾d. per 1000 cubic feet, in the year 1908.

RATES AND GAS, ELECTRICITY, AND WATER CHARGES.

We have received from Mr. James Carter, the Borough Treasurer of Preston, a copy of his tabulated statistics of rates levied, together with charges made for gas, electricity, and water, and profits and losses on municipal undertakings in a number of Provincial towns and a few Metropolitan boroughs, for the year 1910-11. There are in all ninety-four places referred to, which is the same number as in the previous compilation. The populations range from 767,606 (Liverpool) down to 21,584 (King's Lynn).

The rateable values are highest in Westminster (£6,433,299), Liverpool (£4,796,943), Manchester (£4 556,925), Kensington (£2,445,268), and Leeds (£2,149,919), and lowest in King's Lynn (£86,484), Bacup, (£87,392), Brighouse (£88,981), and Stafford (£92,459). The places most heavily rated are: Norwich, 10s. 3d. in the pound; East Ham, 9s. 10d.; West Ham, 9s. 9d.; Sheffield, 9s. 7d.; Wolverhampton, 9s. 5d.; Leeds, 9s. 4d.; Bristol, 9s. 2d.; Rotherham, 9s. 2d.; Preston, 9s. 1d.; Brighouse, 9s.; Halifax, 9s.; and Middlesbrough, 9s. Those which have the lightest rates are: Oxford, 4s. 3d. in the pound; and Bournemouth, 5s.

Out of the rents of property and profits transferred from municipal undertakings, the rates are reduced in the following towns to the extent of 1s. or more in the pound: Nottingham, 1s. 7d.; Macclesfield, 1s. 6¾d.; Warrington, 1s. 4½d.; Darlington, 1s. 4¼d.; Stockport, 1s. 4¼d. (water profits placed to reserve fund); Stafford, 1s. 3¼d.; Burnley, 1s. 2d.; Bolton, 1s. 1⅝d.; Leicester, 1s. 1d. (water, electricity, and tramways profits placed to reserve fund); and Oldham, 1s. On the other hand, small profits in aid of rates were contributed by East Ham, 1d.; Eastbourne, ¾d. (electric light profits to reserve fund); West Hartlepool, ¾d. (electric light profits to reserve fund); Hampstead, ½d.; Middlesbrough, ½d. (gas and electric light profits to reserve fund); and Leamington, ¼d. Out of the total of ninety-four places included in the list, fourteen made no profit for the reduction of the rates; and a separate table gives forty-two instances in which the rates have been increased in consequence of losses on undertakings which were probably in most instances intended to be remunerative. The largest individual loss chronicled has again arisen in connection with docks at Preston (£40,000); the next highest figures have reference to water; while gas does not appear at all in this particular part of the return. Water losses at Bacup were responsible for an addition of 1s. 11d. in the pound to the rates, and at Swansea of 1s. 4½d. Electric light losses were incurred at Brighouse, Barrow-in-Furness, Hastings, and York.

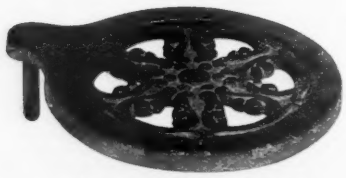
Coming to the table giving the charges for gas and water, we find that the price of gas for domestic supplies is again highest at King's Lynn—3s. 6d. per 1000 cubic feet; while as usual it is the lowest at Widnes, at 1s. 2d. per 1000 cubic feet, with, of course, an even lower rate for large consumers and engines. The following towns also enjoy the privilege of a gas supply for domestic lighting at 2s. or less per 1000 cubic feet; Sheffield, 1s. 4d.; Plymouth, 1s. 8d.; Belfast, 1s. 9½d.; Bath, 1s. 11d.; Huddersfield, 1s. 11d.; Lancaster, 1s. 11d.; Sunderland, 1s. 11d.; Gateshead, 1s. 11⅛d.; Newcastle, 1s. 11½d.; Bradford, 1s. 11¾d.; Bury, 2s.; Bristol, 2s.; Cheltenham, 2s.; Darlington, 2s.; Halifax, 2s.; Oldham, 2s.; and Tynemouth, 2s. The charge per B.T.U. for domestic lighting supplies of electricity ranges from 6½d. at Bournemouth and a flat-rate of 6d. at Hastings to 2½d. (average) at Lincoln, and 3d. at Ashton-under-Lyne, Wolverhampton (average), and West Ham (flat-rate). The charge for water for domestic purposes on a house of £15 rateable value is highest in Ashton-under-Lyne—2s. 1⅝d. in the pound. It is lowest in the following towns: King's Lynn, 7d.; Southampton, 7d.; Liverpool, 7½d.; Brighton, 9d.; and Leamington, 9d. The other places in which the charges are less than 1s. are: Bournemouth, Gloucester, Oxford, Plymouth, Reading, Walsall, Widnes, and York. At Preston (Mr. Carter's own town), the rates are 9s. 1d. in the pound; and they are relieved to the extent of 7d. by the profits transferred from reproductive undertakings. On the other hand, however, there is the deficiency on the docks, which, it is stated, increases the rates by 1s. 10½d. in the pound. The price of gas at Preston for domestic lighting is 2s. 11½d. per 1000 cubic feet; of electricity, 4½d. per unit; and of water, 1s. 2d. in the pound on £15 houses.

There is a table showing the amount estimated for the current year to be transferred to the borough, district, or other fund from the various profitable undertakings.

Metropolitan Water Board and the Sewage of Hertford.—At the meeting of the Metropolitan Water Board last Friday, it was decided to introduce a Bill into Parliament for the cancellation, on terms fair and reasonable to both parties, of the lease held by the Board of the Hertford Sewage Works. This lease was granted to the East London Water Company in 1899 for a term of thirty years; and under it the Board, as successors to the Company, have to dispose of the sewage of Hertford, taking over the liabilities of the Corporation in connection therewith, on consideration of a yearly payment of £700. The Board have brought forward a scheme for discontinuing the use of the Manifold Ditch as an effluent outfall, substituting a new outfall which would join the River Lea at a lower point. The Corporation and the Board have, however, failed to come to terms.

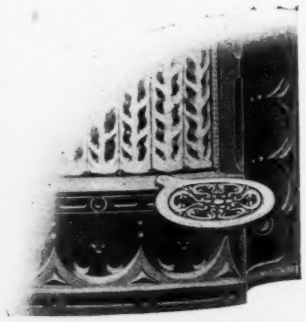
ANOTHER REFINEMENT OF INTERCHANGEABILITY IN OUR GAS FIRES

OUR NEW TRIVET
fits all our new pattern Gas Fires by simply dropping the pivot into the aperture provided in the fender.



Our New Swing-Trivet.

The Neatest—
The Handiest—
The Simplest—
possible arrangement.



Portion of "WIZARD" Gas Fire, showing the New Swing-Trivet in position.

Unfortunately, this contrivance, effective and original though it is, is not of a patentable kind, and no doubt we shall in due course be favoured with the usual compliment of imitation.

When Trivet is ordered in future, the new Trivet will be supplied to all our new pattern fires.

JOHN WRIGHT & CO.,
The Pioneers of Interchangeability and Standardization in the Gas-Stove Industry,
ESSEX WORKS, BIRMINGHAM.

263

SALFORD GAS CHARGES.

Ordinary Consumers to pay Twopence More per Thousand Cubic Feet.

An Adjourned Special Meeting of the Salford Town Council was held last Wednesday to consider the gas charges question.

The Mayor, as Chairman of the Gas Committee, moved the adoption of the Committee's report as to the gas charges (a summary of which was given in our last week's issue), with the following conclusions of the Committee on the position:—

(A.) That the reduction to consumers of large quantities of gas authorized on June 22 be cancelled, and the former scale restored, save and except as amended by clause "B."

(B.) That the price to all consumers, except by slot-meters, be increased by 2d. per 1000 cubic feet as from Dec. 21 next.

After the resolution had been seconded, Councillor Purcell protested against the adoption of the Gas Committee's recommendations. Manchester, he said, could afford 30 feet of gas for a penny to automatic meter consumers; and Salford ought to give the same quantity. He suggested that the report of the Gas Committee as to the gas charges was incorrect and had been manufactured to blind the public.

A somewhat heated discussion followed, during which Councillor Purcell left the Council chamber. Finally, the recommendations of the Gas Committee were adopted by 24 votes to 10.

Councillor Johnson's motion, to the effect that the quantity of gas supplied to slot-meter users be 30 cubic feet, instead of 27 feet, was, on a division, declared to be lost by 17 votes to 11.

PROPOSED IMPROVED LIGHTING AT ACTON.

Offer by the Brentford Gas Company.

At the last Meeting of the Highways Committee of the Acton Urban District Council, a letter was read from Mr. Alexander A. Johnston, the Engineer and Manager of the Brentford Gas Company, submitting proposals for improved lighting. Adverting to a letter sent by him early in June last, in which he offered to re-arrange the lighting of Acton, and at the same time quoted figures showing an annual saving to the Council of some £300 on their public lighting bill, he expressed his pleasure in submitting a revised and further reduced scale of prices. He said that if the District Council would accept the offer made in June, and would enter into a contract to continue the use of gas in the 1072 public lamps mentioned for a period of not less than five years, his Company would undertake to make a further reduction in the price charged for gas, lighting, extinguishing, cleaning, and maintaining the lamps at the following rates per annum: No. 1 Keith gas-lamps (nominal 1500 candles), £11 5s.; Welsbach 300-candle power lamps, £5 3s. 8d.; 4-feet Kern lamps, £2 18s. He further stated that if the Council were prepared to enter into a contract on the same lines for a period of ten years, the Company would also undertake to alter the existing lanterns so that they would take inverted burners of the latest and most up-to-date pattern free of all cost to the Council. The ten-years' contract would be terminable at the end of five or seven years on either party giving six months' previous notice; the Council agreeing, in the event of the contract being so terminated by them, to repay the Company's proportionate part of the capital cost—5-10ths if the contract was terminated at the end of five years, and 3-10ths if at the end of seven years. The cost to the Council for lighting the whole of their district would, under this scheme, be approximately £3984. Mr. Johnston added that this figure was necessarily an approximate one, as the Company did not know the number of lamps to be replaced. The Committee decided that, until the electricity question was settled, they could do nothing in the way of accepting the offer; and they therefore adjourned its consideration *sine die*.

ELECTRIC LIGHT QUESTION AT BISHOP'S STORTFORD.

District Council's Project Abandoned.

At the last Meeting of the Bishop's Stortford Urban District Council, the Electric Lighting Committee presented a report to the effect that they had considered the question of the Council proceeding to carry out their obligations under their Electric Lighting Order, and recommended that the resolution passed at the meeting on the 15th of February last, to proceed with an installation of electric lighting, &c., in the district, on the basis of a report by the firm of electric lighting engineers consulted, be acted upon.

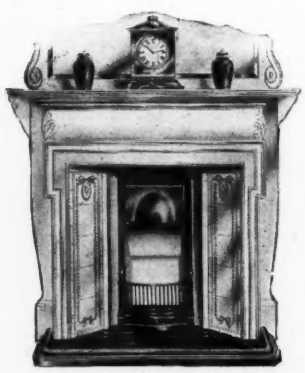
Mr. CARRUTHERS, the Chairman of the Committee, moved the adoption of the report. He pointed out that when this matter was discussed some months ago, a great number of people were willing to take the electric light; and from a study of the figures, he was sure that, after the first year of work, the scheme could be made to pay. What they would lose one year they would gain in another; and he also felt sure that the price of gas in the neighbourhood would be reduced. They had only to turn to the neighbouring town of Saffron Walden for evidence of this. There the price of gas was 2s. 11d.; and he was informed by a councillor from the town that this year there would be a surplus which would go to the relief of the rates. If in Stortford they had their own electric light in competition with the supply of gas, they would get cheap gas and cheap electricity. There was a demand for electricity, and he hoped the Council would not lose such an opportunity. If, as a Council, they had their own installation and supply of electric light and power, whatever profit there was—and there would be profit—would go to the relief of the rates.

Mr. EDWARDS, in seconding the motion, said he was still a believer in the electric light scheme. By undertaking this work, the Council

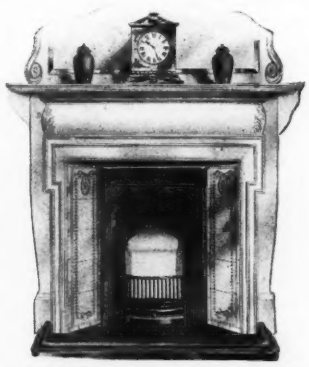
An Advance in Gasfire Fixing.

Richmond's New Adjustable Back covers entirely the Coal Grate, leaving the tiled sides exposed. It is made in three sizes, all adjustable to the extent of 3 in. in height or width. No disturbance of existing fixtures necessary. Suitable for any fire of any size but particularly suitable for Richmond's "A.B.C." Series.

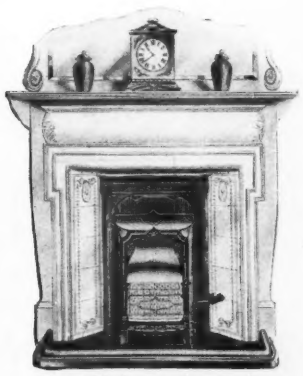
Price from 22s. 6d. List.



Showing ordinary fireplace ready for fixing adjustable back.



Adjustable back in position, takes but a few seconds to fix ready for gasfire.



Adjustable back and gasfire in position all ready for use.

Richmond Gas Stove and Meter Co., Ltd.,

Inventors of the Interchangeable "A.B.C." Gasfire Series.

would do a good stroke of business for the town, because he thought very shortly they would have to go to more expense for providing power at the water and sewage works. If the Council could put a good light into every cottage, they would be doing a fine thing for the town without loss to the ratepayers. He heartily supported the resolution that the work should go forward.

Mr. WATTS quite agreed with Mr. Edwards that if it were possible to light every cottage for 1d. per 48 hours it would be a splendid thing; but he thought that instead of the scheme costing something like £12,000, as estimated, it would amount to £36,000. Each extension of the cable would increase the cost; and this would necessitate the enlargement of the capacity of the generating station. In addition to these objections, he considered the Council were working entirely in the dark, as they were simply assuming that they would get a certain amount of support. He hoped the Council would see at once the desirability of not entertaining the scheme.

Mr. W. J. GEE, the Chairman of the Council (who, being personally interested in the subject under discussion, had vacated the chair and been replaced by the Vice-Chairman), said that, in his opinion, judging from the figures submitted to them, to embark on electric lighting would not be a very good business arrangement for the Council. They would run some risk; and it seemed to him that they would not be justified in asking the town to lay out a large sum of money on an undertaking like the one before them. He thought it would be remembered that the point had been raised as to whether the old-fashioned electric lamp did not consume something like 50 per cent. more current than the new metallic filament lamp. Therefore they had to cut the last return (he believed for 1938) in two to come at their income.

Mr. KENT remarked that the area proposed in the estimate presented to the Council was larger than that proposed by the Gas Company.

Mr. WATTS remarked that a great deal had been said with regard to the tyranny of the Gas Company; but they need not fear them. The cottager would in the future be able to have his own light. He could install in his house a light at less cost than the gas by means of an apparatus one could almost put in his pocket.

The VICE-CHAIRMAN (Mr. J. L. Glasscock) said he agreed with Mr. Gee, and thought the proposed installation could hardly be carried out for less than £24,000. He consequently would not be able to support the resolution.

The CLERK (Mr. T. Swatheridge), in reply to a question, read the section of the Gas Company's recent Act to the effect that they cannot undertake the supply of electricity until any powers vested in the Council shall have been revoked or shall have ceased to exist.

After some further remarks, the motion was lost by seven votes to five.

The VICE-CHAIRMAN then gave notice that at the next meeting of the Council he would move that the resolution of the 15th of February last now standing upon the minute-book be rescinded.

It was afterwards unanimously resolved to communicate to the Board of Trade the result of the discussion; and it was announced that the Electric Lighting Committee would not be called together again.

REDHILL AND REIGATE PUBLIC LIGHTING.

Settlement of the Dispute with the Redhill Gas Company.

In the "JOURNAL" for the 8th ult. (p. 422), reference was made to a dispute which had arisen between the Corporation of Reigate and the Redhill Gas Company on the subject of the renewal of the contract for the public lighting. The matter was under consideration at the meeting of the Corporation on Monday last week, when letters were read which showed that a settlement had been come to. This was the result of negotiations which had taken place between the Town Clerk (Mr. Alfred Smith) on the instructions of the Highways and Works Committee, and the Engineer and Manager of the Gas Company (Mr. W. H. Bennett). The Town Clerk read a letter he had received from Mr. Bennett, in the course of which he said that, after consideration of the various points brought forward, and taking into account the improbability of the Council wishing to convert more than 10 per cent. of the existing lamps (as mentioned by their deputation), he accepted, on behalf of the Company, the offer for a further three years' contract on the following terms: To light, extinguish, clean, and maintain the existing 389 public lamps at £3 per lamp per annum in respect of each ordinary incandescent lamp, and £3 2s. 6d. per lamp per annum in respect of each Marriage suspension lamp—the Corporation to be permitted to convert 39 lamps during the period covered by the contract without charge, but they would be charged at the rate of £1 per lamp per annum in respect of each lamp converted beyond the number allowed. In reply, the Town Clerk wrote that he had little doubt as to the arrangement come to being confirmed by the Council. Mr. H. Ongley moved that the offer of the Gas Company should be accepted, and a contract in accordance with it sealed. He thought the thanks of the Council were due to the Town Clerk for the efforts he had made in bringing about a satisfactory conclusion to the difficulty. Mr. M. Dean seconded the motion; and it was carried.

Electricity Supply in London.—A joint conference of London electric supply authorities was held at the Cannon Street Hotel last Thursday—Mr. Ernest Debenham, Mayor of Marylebone, occupying the chair. An interim report of the Executive Committee, which was adopted, dealt with the extensive work which has been carried out during the past year in setting out the basis of a linking-up scheme under the London Electric Supply Act, 1908. Reference was made to the valuable information of a confidential character which had been collated by the Joint Engineers' Committee, bearing on the question of the supply to London, upon which the engineers are still engaged. The Executive Committee was reappointed. A resolution was passed expressing appreciation of the work of the Electric Supply Publicity Committee; and it was decided to subscribe a substantial amount to the funds of the Committee, on a revenue basis, for the purpose of the development of a still more vigorous advertising programme.

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I am placed in a peculiarly advantageous position, as those responsible for my being GUARANTEE me and stake their reputation upon me. Their confidence and yours is well placed. Gas Engineers, Architects and others whose judgment carries weight KNOW that they can safely elect me to represent them, not only IN THE HOUSE, but in churches, public edifices of all kinds, and in the palaces of commerce.

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THE SMOKE EVIL.

A Lecture on the Subject at Glasgow.

In the course of a lecture under the auspices of the Glasgow Health Culture Society, on the subject of air purification, Mr. Peter Fyfe, Sanitary Inspector, made some interesting references to the bearing of gas on the question of the smoke evil. There were, he said, three classes of inhabitants to whom the matter of smoke abatement was apparently but of academic interest.

There was the person who, with gas served to him by the Corporation at 2s. per 1000 cubic feet, pleaded that for 12 hours' constant burning a gas-fire would cost 2½d. more than a coal-fire would. The man who grudged 2½d. per day for a gas-fire did not take much account of the dirt and ashes from a coal-fire, the labour of cleaning, sweeping, and dusting, and the deterioration of furniture and household belongings, all of which would be saved by the use of gas.

Then, secondly, there was the prejudiced person, to whom gas in the grate was insufferable. This person did not speak of the small extra cost, but of the fumes and the hot, stuffy atmosphere. He (the lecturer) was in no way prejudiced in favour of the gas-fire. He knew its drawbacks as compared with the bright, blazing coal-fire, its uselessness as a paper burner and refuse destructor, its comparative deficiencies under ordinary circumstances as a water-heater, and its weakness as compared with the coal-fire in gusty weather to resist down-draughts; but from prolonged observation and experiment, he was prepared to deny that it caused, if properly constructed, offensive fumes, or that it engendered a stuffy atmosphere in the rooms in which it was employed. It might be quite freely admitted that, in the older type of gas-fires, with the ball-fuel or asbestos shavings laid close to the flaming gas-jets, fumes were created and emitted which were objectionable. It was a trite saying that smoke was caused by imperfect combustion. Gas-fumes were also caused by imperfect combustion. Another statement of the prejudiced person was that with reference to the stuffiness of rooms heated with gas-fires, and the dry heat such fires gave in comparison with coal-fires. Here, again, recent experiments carried on continuously for six months proved the fallacy of such statements.

The third class of people for whom smoke abatement had no interest were the poorer citizens. He was bound to say at once that, even assuming they could afford to purchase, or even hire, gas-fires or gas-cookers, they could hardly afford to burn in them gas at 2s. per 1000 cubic feet. The poorer classes required some differential treatment. They got it now by law in the payment of their rates; and if the air of Glasgow was ever to be purified, they must also get it in the payment for their gas. If they could get gas supplied to them at 1s. 4d. per 1000 cubic feet, instead of 2s., he believed most of them could be induced to hire the stoves and rings they needed from the Corporation. An alternative to this was that the Corporation in their gas-works should produce in sufficient quantities a coke-fuel containing such a fair proportion of hydrocarbons or inflammable matter as would make a reasonable substitute for the raw coal now burned. To take all, or nearly all, the gas out of the coal and sell the residue as coke to the poor, would not effect the purpose in view. The fuel that did not light easily, that had little or no flame, and that required a good draught to consume it, was of no use in the humbler homes of Glasgow, no matter how cheap it might be.

Alluding to the utilization of electricity, he said there was not the least doubt in the mind of any unbiassed person that, for yielding both heat and power, electricity was in the forefront of all other agencies. It alone could make the ideal factory and dwelling-house; but its use was still beyond the citizen who had to study ways and means, being dear as compared with gas, and expensive as compared with coal.

MITIGATION OF THE SMOKE NUISANCE.

Advantages of Cheap Gas.

Last Friday, a deputation from the Manchester and Salford Sanitary Association had an interview, at the Manchester Town Hall, with the Gas Committee of the Corporation, for the purpose of urging the necessity of something being speedily done to mitigate the smoke nuisance.

Mr. T. C. HORSFALL, the Chairman of the Association, said the people in Manchester were debarred from enjoying fresh air and light owing to the prevalence of smoke and fog, which alike were highly detrimental to the healthy development of the citizens. The deputation had come to beg the Gas Committee of the Corporation to encourage the use of gas in place of the small, smoky fires, by reducing the price. An apparent sacrifice might have to be made by the Corporation; but for every £1000 of loss the city would gain tens of thousands of pounds in the way of added health to the community.

Sir ALFRED HOPKINSON, the Vice-Chancellor of the University, expressed the view that cheaper gas would greatly diminish the density of fogs, for most of the black smoke came, he said, from the chimneys of dwelling-houses.

Mr. J. W. GRAHAM, Principal of Dalton Hall, remarked that the use of gas was the only cure in sight for domestic smoke. At 2s. 3d. per 1000 cubic feet, gas was rather more costly than coal; but if the price were reduced to 1s. 9d., he felt sure a great extension of its use for fires and cooking purposes would follow. The immediate responsibility rested with the Council, who hitherto had not been willing to sell gas as cheaply as they could. He knew that 3d. per 1000 cubic feet taken off the price of gas would mean 4d. in the pound on the rates; but surely there were men courageous enough to lay this before the public. A week of fog in Manchester would kill between 200 and 300 people.

Other speakers having addressed the Committee,

Mr. T. C. ABBOTT, who introduced the deputation, read a letter from Professor Harold B. Dixon, who expressed his regret at being unable to

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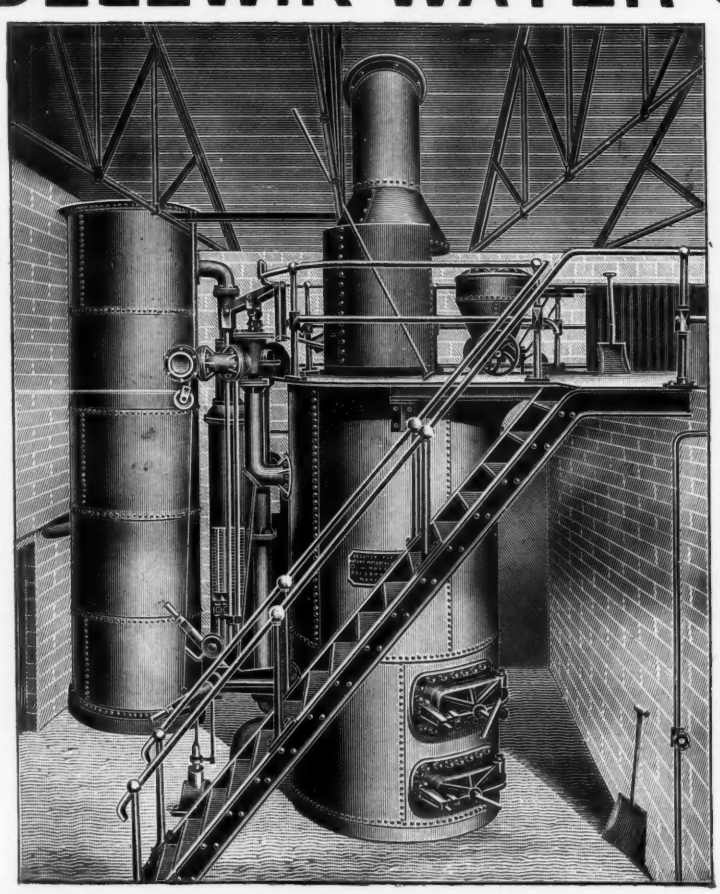

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join the deputation, and add his voice to theirs in asking for cheaper gas. Professor Dixon wrote as follows: "I have been studying the chemistry of burning gases for more than thirty years, and the more I learn the more I am convinced that a cheap gas supply of moderate candle power is, by its efficiency, economy, and flexibility, a most valuable asset in the well-being of a large city. I say moderate candle power because I believe it is wasteful nowadays to supply a gas of high illuminating power, as tested by an official argand or a flat-flame standard burner. . . . The use of the incandescent mantle has made it possible to supply a gas which may be used economically both for lighting and heating. Many inventors are busy on the improvement of incandescent fires; and a cheaper gas would give an immense impetus to their development and use. The ratepayer who uses a gas-stove instead of a smoky fire is a public benefactor; and we mark our sense of obligation to him by fining him for the benefit of the others."

Alderman GIBSON, the Chairman of the Gas Committee, in reply, said that, personally and for the Committee, he was influenced by the same feelings on the matter as those shared by the deputation. Nothing would conduce more to the purifying of the atmosphere of the city than a more general use of gas and electricity. He had done all he could to reduce the price of gas; and the figure in Manchester had never been so low as it was now. At the same time, so long as the Committee had to hand over £50,000 a year from the gas profits to relieve the rates of the city, it was altogether impossible for them to do more than they were doing at present. The great point to be borne in mind was that the Committee were taking thousands of pounds a year out of the pockets of poor consumers and putting them into those of rich ratepayers who did not use gas at all. This was a gross injustice, to put the matter in the mildest form; and he would recommend the Association to continue to educate opinion in the value of cheap and plentiful light.

Mr. ABBOTT thanked the Committee for their courteous reception, and the deputation withdrew.

NEW WATER SUPPLY FOR VIENNA.

As the result of ten years' labour and an outlay of about £4,200,000, Vienna was last Friday provided with a second main water supply by the opening of the new aqueduct from the region of the Seven Lakes, near Hochschwab. Some details of this great scheme were given in the "JOURNAL" five years ago. The sources of the new supply are in the valley of the Styrian Salza, more than 7000 feet above the level of the sea. Thence the water is brought to the city, a distance of about 130 miles. For the greater part of the way it is conveyed through underground pipes, but in places by aqueduct bridges. The engineering difficulties were considerable; in one place it being necessary to tunnel the mountains for more than three miles. The longest aqueduct is 800 feet in length and 75 feet in height. Two rivers and several streams had also to be tunnelled under. An enormous quantity of material was required for the work. Among the principal items were 140,000 tons of cement, 33,500 tons of cast-iron piping, and 2600 tons of wrought-iron piping. The daily supply of water from the new works is estimated at 44 million gallons, which, added to the 15½ millions from the existing sources, will provide Vienna with all the water it can possibly need for several decades. The new supply is said to be of excellent quality; and every care has been taken to preserve its purity. The Municipality have bought 12,500 acres of land surrounding the reservoirs at the sources, besides which a very large district has been specially enclosed as a protective area, in which no mining or works of any other kind which could possibly affect the water there will be permitted. Owing to the great height of the springs supplying the aqueduct, the water distributes itself to all but the highest points of the Vienna municipal district; and it flows so rapidly that it provides electrical power sufficient to pump the supply to the places not otherwise reached. The opening ceremony was performed at the Rathaus by the Emperor touching an electric button; and it inaugurated the 63rd year of his reign.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Edinburgh and Leith Gas Commissioners on Monday had a discussion upon the question of paying commission in respect of mortgages granted, which is understood to be commission to parties who bring to the Commission money to be lent on mortgage. That such a practice prevails in the district is shown by the circumstance that representatives of the Gas Commission, the Town Councils of Edinburgh and Leith, the Water Trust, and the Water of Leith Purification Commissioners, met in conference on the subject, and, by a majority, agreed to recommend that commission be paid to accredited agents of lenders. The Commissioners on Monday approved of the recommendation, and continued the subject; there being still undecided the amount of the commission to be allowed, and still unconsidered a proposal that the local bodies should meet annually to fix the rate of interest to be from time to time allowed on mortgage debt.

The Commissioners had read to them a letter by a Law Agent on behalf of Mr. F. Cochrane, of Leith, with regard to a statement by whom, during the recent municipal election, to the effect that members of the Corporations of Edinburgh and Leith obtained privileges over other gas consumers, objections were taken at the previous monthly meeting. The Law Agent said that his client informed him that the remark was based upon the faith of statements by individuals in the employment of the bodies mentioned; that his client had no desire that his informants should run any risk of being made to suffer for anything they had said to him; and that he could not, therefore, see his way to supply their names. It was pointed out, however, at the request of the client, that the statement had reference to some former members of the Edinburgh and Leith Corporations, and that when Mr. Cochrane made the statement he did not have in his mind, nor

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mean to refer to, present members; his sole object being to elicit whether a similar practice to that mentioned was still in existence to any extent. His client authorized him to state that he gladly accepted Mr. Herring's assurance that, so far as the Gas Commissioners were concerned, the members of the Edinburgh and Leith Corporations were not treated in any way different from other consumers; and he instructed the writer to express his sincere regret if he had caused any pain or annoyance to the present members of the Corporations. Provost Smith, of Leith, pointed out that it was stated that the charge was not made with reference to the present members of the Corporations, and he went on to say that he did not know that this made the matter any better. It was, in his opinion, a slander upon their officials; and he thought that if they dealt with the matter further it should be in private. This was agreed to, and the subject was sent to the Finance and Law Committee to consider.

At the meeting of the Western District of the Scottish Junior Gas Association in Glasgow to-night, the important and appropriate subject of fuel calorimetry was considered. Mr. G. Braidwood, the Assistant Gas Manager at Coatbridge, who introduced the subject, was, as the President remarked, well qualified for the handling of the matter, having previously been Chemist at Dawsholm, with an up-to-date laboratory at his command. The subject is one which, it may be admitted, few except a junior could do justice to, because in a works sufficiently large to keep a laboratory going the Manager has not time to devote to systematic testing, which then devolves upon an assistant. Mr. Braidwood discharged his duty well, so that there was nothing for the members to discuss. But, of course, there must have been very few present who have had the experience which would have justified them in expressing an opinion. The paper was an informative one; and as such will be welcomed by many to whom the practice of calorimetric estimating is as yet a new subject.

CURRENT SALES OF GAS PRODUCTS.

[For Table of "Tar Products Prices," see p. 739.]

LIVERPOOL, *Dec.* 3.

Sulphate of Ammonia.

Although new orders from direct buyers have been somewhat scarce this week, the requirements of dealers for covering former sales have been sufficient to maintain values at the lower level reported last week. There has been a fair quantity of sulphate coming on the market; but it has been taken up as it has become available, and the quotations at the close remain £12 12s. 6d. per ton f.o.b. Hull, £12 13s. 9d. per ton f.o.b. Liverpool, and £12 15s. per ton f.o.b. Leith. Little interest is being shown by consumers for future delivery; buyers refusing to concede the price asked by manufacturers, and it being reported that second-hand sellers are offering at less money.

Nitrate of Soda.

The market is still without any new feature; the tone being quiet, and holders continuing to quote 9s. 4½d. per cwt. for 95 per cent. and 9s. 7½d. for 96 per cent. quality, on spot.

LONDON, *Dec.* 5.

Tar Products.

The markets for tar products have remained fairly firm during the past week. In pitch, there has been a fair amount of inquiry for forward delivery; but buyers will not pay the prices which are being asked on this side. On the other hand, distillers are very firm in their ideas of price. It is most difficult to do business at the prices being asked at the moment for benzol. Creosote is quiet, and transactions are reported at fairly low prices. In crude carbolic acid, makers still report that they are receiving offers at 1s. 1½d. to 1s. 2d. per gallon. On the other hand, consumers do not offer more than 1s. 0⅞d. to 1s. 0¾d. per gallon. Heavy naphtha is fairly firm.

The average values during the week were: Tar, 16s. 6d. to 20s. 3d. *ex* works. Pitch, London, 34s. to 34s. 6d.; east coast, 32s. 6d. to 33s. 6d; west coast, Clyde ports, 33s. to 34s., Manchester, 32s. to 33s., Liverpool, 32s. 6d. to 33s. Benzol, 90 per cent., casks included, London, 8d. to 8⅛d.; North, 7⅞d. to 7¾d.; 50-90 per cent., casks included, London, 8d. to 8⅛d.; North, 7¾d. to 8d. Toluol, casks included, London, 9d. to 9⅛d.; North, 9d. Crude naphtha, in bulk, London, 3¾d. to 4⅛d.; North, 3⅝d. to 3¾d.; solvent naphtha, casks included, London, 11⅛d. to 1s.; North, 10⅛d. to 11d.; heavy naphtha, casks included, London, 11⅜d. to 1s.; North, 11d. to 1s. Creosote, in bulk, London, 2⅝d. to 2¾d.; North, 1⅞d. to 2⅛d. Heavy oils, in bulk, 2¾d. to 2⅞d. Carbolic acid, 60 per cent., casks included, east coast, 1s. 1½d.; west coast, 1s. 1d. Naphthalene, £4 10s. to £8 10s.; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1⅛d. to 1⅜d. per unit, packages included and delivered.

Sulphate of Ammonia.

The market remains steady; and the Northern ports seem to be a trifle better than London. The inquiry has been fairly good during the past week. Outside London, makes are quoted at £12 6s. 3d. to £12 7s. 6d. In Hull, the price is £12 17s. 6d.; Liverpool, £12 17s. 6d.; Leith, £12 17s. 6d.; and Middlesbrough, £12 16s. 3d. to £12 17s. 6d. For the forward position, makers still maintain their ideas of high prices.

Public Lighting of Coedpoeth (Wrexham).—Last Friday witnessed the inauguration of the public lighting of Coedpoeth, as on the evening of that day the street-lamps recently fitted up were lighted for the first time. They have been erected, according to the directions of the Parish Council, by the Wrexham Gas Company, who have also extended their mains to a number of roads. Most of the residents will, therefore, be able to have the gas supply connected with their houses. The question of street lighting has been under consideration for many years; and now that it has been accomplished, its utility and benefit are recognized by all sections of the community. Though the necessary rate will be 6d. in the pound for the first three years, it is estimated that there will be a considerable reduction afterwards.

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COAL TRADE REPORTS.

Northern Coal Trade.

There is a better demand for coals, and the shipments have been heavier, and are likely to continue so, as there is a desire to accumulate a little stock before the coming holidays. In the steam coal trade, the request is fair, and prices seem a little firmer. Best Northumbrian steams are from 9s. 4½d. to 9s. 9d. per ton f.o.b., second-class steams are about 8s. 3d. to 8s. 6d., and steam smalls are from 4s. 9d. to 6s. 3d. In the gas coal trade, the demand is now at its fullest for this season, and deliveries on the long contracts take up most of the output of the chief collieries. Durham gas coals are from 8s. 3d. to 9s. per ton f.o.b. for the usual classes, according to quality. For "Wear specials," from 10s. 3d. to 10s. 6d. per ton f.o.b. is the current quotation. There has been a sale of some 40,000 tons of gas coal for delivery over the next four months, at a price which is calculated to leave 8s. 6d. per ton f.o.b. There are also more contracts in negotiation for the supply of the London Gas Companies, and it is stated that in some instances about 1s. 3d. less than the prices under the contracts now running is being offered in the new contracts; but the bargains are not yet complete. Coke is quiet. Good gas coke is about 14s. 6d. per ton f.o.b., with a heavy supply.

Scotch Coal Trade.

Home trade is more active, but not sufficient to affect prices. In the foreign trade, orders are very limited. Small stuffs are difficult to sell. The prices now quoted are: Ell, 9s. 3d. to 10s. per ton f.o.b. Glasgow; splint, 9s. 6d. to 9s. 9d.; and steam, 9s. to 9s. 3d. The shipments for the week amounted to 300,840 tons—a decrease of 3746 tons upon the preceding week, and of 6163 tons upon the corresponding week last year. For the year to date, the total shipments have been 14,649,476 tons—an increase upon the corresponding period of 671,807 tons.

Strabane Water Supply.—The Strabane Urban District Council have adopted the estimate of the Engineer in connection with the proposed water scheme, at a cost of £3545, and have decided to apply for a loan of £4000 to carry out the work.

Gas-Works Damaged by Floods.—Owing to the recent heavy rains, the towns and villages along the banks of the Loire, the Rhône, and the Saône are being inundated. A similar state of affairs prevails at Samur, where both the gas-works and the electric light station are flooded. The town was in darkness last Wednesday night, as was also the town of Angers. Ancenis, further up the river, is without drinking water, gas, or electricity.

Burst in a Liverpool Water-Main.—A burst occurred last Tuesday on the Liverpool water-pipe line at Cotebrook, a village seven miles from Northwich. A fissure 5 feet in length was caused in the pipe, which is 3 feet in diameter and 1¾ inches thick, through which large volumes of water rushed, tearing up a field for 30 yards, and forming a chasm 20 feet deep and 30 feet wide, and another of smaller dimensions. The main road was torn up and the Northwich Council's waterworks were flooded. The Liverpool mains being in duplicate, the supply of water to the city was not affected.

Ventilation of Street Boxes.—In view of the explosions which have occurred, the Woolwich Borough Council recently sent a circular-letter to the other Metropolitan Borough Councils, asking them to communicate with the London County Council and urge the desirability of regulations being framed to secure the ventilation of street inspection boxes. The Battersea, Bethnal Green, Bermondsey, Chelsea, Deptford, Finsbury, Hampstead, Kensington, Lewisham, and Stepney Councils agreed to support the request; the Paddington and Westminster Councils replied that they were not in favour of the proposal; and the Holborn, Marylebone, and Wandsworth Councils wrote that they had decided not to take any action in the matter.

Chertsey Gas Company, Limited.—The annual meeting of this Company was held last Tuesday—Mr. William Moir in the chair. The Secretary (Mr. John Moir) read the Directors' report, in which they recommended the payment of the statutory dividends of 12 and 9 per cent., less income-tax. The Chairman, in moving the adoption of the report, said he thought, if the shareholders looked at the figures in the accounts, they would agree with him it was an excellent report, and showed a good year's working. The Directors were quite exuberant at the success of their invitation for tenders for the new capital, which was over-subscribed by £2000. The Company were making headway in every direction. Mr. W. Kempson seconded the motion, and heartily congratulated the Directors on the excellent condition into which they had brought the undertaking. The report was adopted. In acknowledging a vote of thanks to the officers, Mr. J. Moir said both he and the Manager (Mr. H. J. Hamilton) had done their level-best for the Company ever since they had been connected with it.

Local Legislation Committee's Report.—The special report from the Select Committee on Local Legislation (ordered by the House of Commons to be printed on the 22nd ult.) has now been issued. Only two paragraphs of it are of particular concern to our readers. Noticing the Middlesbrough Corporation Bill, the Committee say: "Middlesbrough gave evidence of the fraudulent operations of coke-hawkers, who give short weight, or damp the coke to make it heavier; and, when approached by the Inspector of Weights and Measures, profess to be selling by bag and not by weight. A clause was allowed, compelling coke-hawkers to have every sack labelled with its correct weight of coke." Dealing with the smoke nuisance clauses of the London County Council Bill (which were opposed by, among many other petitioners, the London Gas Companies) the report contains this paragraph: "In order to deal with smoke nuisance, the London County Council sought to amend the law dealing with a nuisance produced by smoke, by the omission of the defining word 'black.' Your Committee heard a considerable volume of evidence, both on behalf of the promoters and of the opponents—including the London Chamber of Commerce. As the County Council were unwilling to accept any limitation on their suggested clause, your Committee, in view of the serious effect it might have on the industries of London, did not allow the clause."

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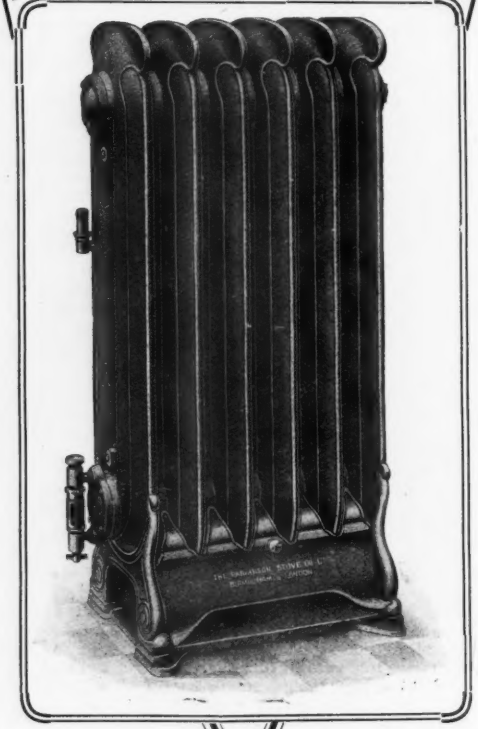

The Tottenham and Edmonton Gas Company having agreed to fix automatic lighting appliances to street-lamps in certain agreed positions, to enable the Highways Committee to see the system at work, the Surveyor has been instructed to arrange with the Company for the erection of them at their own expense.

In view of the approaching "shopping week" at Reigate and Redhill, which has been fixed for the period between the 10th and 24th inst., the Redhill Gas Company secured the back page of the "Surrey Mirror" for last Friday for a very effective advertisement of their commodity, which is characterized as "the convenience of the age and the best domestic servant."

At to-morrow's meeting of the Association of Engineers-in-Charge, a paper will be read by Mr. John B. C. Kershaw, F.I.C., entitled "Practical Notes on the Working and Control of Steam-Boilers." Dr. H. S. Hele-Shaw, F.R.S., will take the chair.

As the result of excessive grief consequent upon the loss of his wife, a young man named William Henry May, an employee of the South Metropolitan Gas Company, died in St. Bartholomew's Hospital on the 26th ult. from the effects of taking poison. At the Coroner's inquest on Tuesday, a verdict of "Suicide" was returned, as there was not sufficient evidence to show the Jury the state of May's mind.

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MOUTHPIECES. Sutton (Surrey) Gas Company.
PUMPING ENGINE, PUMPS, &c. Tonbridge Water Works Company.

Lectures, &c.
GASEOUS FUEL AND COMBUSTION. Imperial College of Science and Technology. Particulars from the Secretary.
COAL GAS, GAS LIGHTING, AND PHOTOMETRY, &c. Leeds University. Particulars from the Registrar.

TENDERS FOR
Fire-Clay Goods.
SALFORD GAS DEPARTMENT. Tenders by Dec. 15.
Meters.
LLANDUDNO URBAN DISTRICT COUNCIL.
Stoves and Grillers.
GLASGOW GAS DEPARTMENT. Tenders by Dec. 27.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending Dec. 3. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast.		Glasgow.
					Liverpool.	Manchester.	
Tar crude	per ton	21/–	18/6—21/–	19/—21/3	18/6—21/–	18/6—21/–	—
Pitch	,,	35/–	32/—32/6	32/6	33/–	32/—32/6	32/6
Benzol, 90 %	per gallon	–/9	–/7¼—/8	–/8	–/7¼—/7½	–/7¾—/8	–/8
Benzol, 50-90%	,,	–/9¼	–/8¾—/8½	–/9	–/8—/8¼	–/8—/8½	—
Toluol, 90%	,,	–/10	–/9—/9¼	–/10	–/10	–/9½—/10	–/10
Crude naphtha, 30%	,,	—	–/3¼—/3½	–/3½	–/3¼—/3½	–/3¼—/3½	—
Light oil, 50%	,,	—	–/3¼	–/3½—/3¾	–/3—/3½	–/3—/3½	—
Solvent naphtha, 90-160	,,	—	–/10½—/11	–/10	–/10—/10½	–/11½—1/–	–/11
Heavy naphtha, 90-190	,,	—	–/11	–/11	–/11¼—/11¾	–/11¼—1/–	–/11
Creosote in bulk	,,	–/2½—/2¾	–/2—/2¼	–/2	–/2—/2⅛	–/2—/2⅛	–/2
Heavy oils	,,	–/3¼	–/2⅛	–/2¼	–/2¾	–/2¾—/3	–/3
Carbolic Acid, 60's	,,	1/1	1/—1/1	1/1	1/0½—1/1	1/0½—1/1	1/1
Naphthalene, crude drained salts	per ton	—	42/6—45/–	40/—42/6	47/6	47/6—50/–	—
Naphthalene, pressed	,,	—	60/–	63/–	60/–	60/—72/6	—
,, whizzed	,,	80/–	—	—	70/—72/6	70/—75/–	65/–
Anthracene	per unit	–/2	–/1⅜	–/1½	–/1¼	–/1¼	—

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 701.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
551,863	Stk.	Oct 14	5	Alliance & Dublin Ord.	83–86	..	5 16 3
374,000	Stk.	July 14	4	Do. 4 p.c. Deb.	91–98	..	4 1 8
200,000	5	Oct. 28	7	Bombay, Ltd.	0⅛–0⅜	..	5 3 8
40,000	5	,,	7	Do. New, £4 paid	5–5⅛	..	5 6 8
50,000	10	Aug. 31	15	Bourne- mouth Gas and Water Pref. 6 p.c.	28½–29½	..	5 1 8
311,810	10	,,	7		16⅜–16⅝	..	4 3 7
75,000	10	,,	6		14⅜–15⅛	..	3 18 8
300,000	Stk.	Aug. 12	12½	Brentford Consolidated	245–251	..	4 19 7
310,000	,,	,,	9⅜	Do. New	185–188	..	5 1 1
50,000	,,	,,	5	Do. 5 p.c. Pref.	120–122	..	4 2 0
205,250	,,	June 10	4	Do. 4 p.c. Deb.	99–101	..	3 19 3
220,000	Stk	Aug 31	1	Brighton & Hove Orig.	215–218	..	5 0 11
246,320	,,	,,	8	Do. A Ord. Stk.	158–161	..	4 19 5
460,000	20	Sept. 23	10⅝	British	44–45	..	4 12 4
109,000	Stk.	Aug 11	6	Bromley, A 5 p.c.	117–119	..	5 0 10
165,700	,,	,,	4½	Do. B 3½ p.c.	88–90	..	5 0 0
82,278	,,	,,	5½	Do. C 5 p.c.	107–109	..	5 0 11
57,000	,,	June 29	3½	Do. 3½ p.c. Deb.	85–87	..	4 0 6
250,000	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	97–99	..	4 0 10
100,000	10	—	—	Cape Town & Dis., Ltd.	3–4	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4½–5⅜	..	—
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	—	..	—
100,000	Stk.	June 29	4½	Do. 4½ p.c. Deb. Stk.	90–92	+2	4 17 10
157 150	Stk.	Aug. 12	5	Chester 5 p.c. Ord.	109½–111½	..	4 9 8
1,513,280	Stk.	,,	5 5/8	Commercial 4 p.c. Stk.	106–109	..	4 15 5
560,000	,,	,,	5	Do. 3½ p.c. do.	101–103	..	4 17 1
475,000	,,	June 29	3	Do. 3 p.c. Deb. Stk.	79–81	..	3 14 1
800 000	Stk.	June 10	4†	Continental Union, Ltd.	88–93	..	4 6 0
200,000	,,	,,	*	Do. 7 p.c. Pref.	137–139	..	5 0 9
491,270	Stk.	—	5½	Derby Con. Stk.	122–124	..	4 8 9
55,000	,,	—	4	Do. Deb. Stk.	104–105	..	3 16 2
143,995	,,	Oct 14	5	East Hull 5 p.c. Ord.	103–105	..	4 15 3
486,090	10	July 14	12	European, Ltd.	23⅝–24¼	..	4 19 0
354,060	10	,,	12	Do. £7 10s. paid.	17⅞–18¼	..	4 18 8
16,179,445	Stk.	Aug. 12	4⅜	Gas light and Coke Ord.	104⅜–106⅝	+⅝	4 7 5
2,600,000	,,	,,	3½	3½ p.c. max.	87–89	..	3 18 8
4,062,235	,,	,,	4	4 p.c. Con. Pref.	103–105	..	3 16 2
4,531,705	,,	June 29	3	3 p.c. Con. Deb.	85–92	..	3 13 2
258,740	Stk.	Sept 15	5	Hastings & St. L. 3½ p.c.	92–94	..	5 6 5
82,500	,,	,,	6⅓	Do. do. 5 p.c.	114–116	..	5 12 1
70,000	10	Oct. 14	11	Hongkong & China, Ltd.	17–17½	..	6 5 8
131,070	Stk.	Sept. 15	7⅜	Ilford A and C	145–148	..	4 19 8
65,780	,,	,,	5⅜	Do. B	112–114	..	5 3 1
65,500	,,	June 29	4	Do. 4 p.c. Deb.	93–100	..	4 0 0

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
4,940,000	Stk.	Nov. 11	9	Imperial Continental	185–187	+1	4 16 3
1,235,000	Stk.	Aug 12	3½	Do. 3½ p.c. Deb. Red.	94–96	..	3 12 11
200,242	Stk.	Aug. 31	6	Lea Bridge Ord. 5 p.c.	120–21	..	4 18 4
561,000	Stk.	,,	10	Liverpool United A	220—222	..	4 10 1
718,100	,,	,,	7	Do. B	163–165	..	4 4 10
306,083	,,	June 29	4	Do. Deb. Stk.	104–106	..	3 15 6
75,000	5	June 29	6	Malta & Mediterranean	4⅜–5	..	6 0 0
560,000	100	Oct. 1	5	Met of 5 p.c. Deb	99–101	..	4 19 0
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	99–101	..	5 9 10
541,920	20	Nov. 11	3½	Monte Video, Ltd.	12¼–12⅜	..	5 9 10
1,775,892	Stk.	July 28	4⅜	Newc'tle & G'tesh'd Con.	102–103	..	4 5 0
329,435	Stk.	June 29	3½	Do. 3½ p.c. Deb.	90–91	..	3 16 11
55,940	10	Aug. 31	7	North Middlesex 7 p.c.	15⅜–14½	..	4 16 7
300,000	Stk.	Nov. 30	8	Oriental, Ltd.	136–136*	+2¼	5 15 11
60,000	5	Sept. 15	8	Ottoman, Ltd.	6¼–6⅜	..	5 18 6
31,800	53	Aug. 31	13	Portsea Island A.	131–133	..	5 3 0
60,000	50	,,	13	Do. B.	124–126	..	5 3 2
100,000	50	,,	12	Do. C.	117–119	..	5 0 10
114,800	50	,,	10	Do. D and E.	102–104	..	4 16 2
398,490	5	Oct. 28	7	Primitiva Ord.	7⅛–7⅜	..	4 13 4
796,980	5	June 29	5	Do. 5 p.c. Pref.	5⅛–5⅜	..	4 13 0
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	95–97*	..	4 2 6
312,650	Stk.	June 29	4	River Plate 4 p.c. Deb.	97–99	..	4 0 10
250,000	10	Sept 29	9	San Paulo, Ltd.	15⅛–15⅝	..	5 14 3
62,500	10	,,	6	Do. 6 p.c. Pref.	11¼–11⅝	..	5 2 2
125,000	50	July 1	5	Do. 5 p.c. Deb.	51–52	..	4 16 2
135,000	Stk.	Aug. 31	10	Sheffield A	229–231	..	4 6 7
209,984	,,	,,	10	Do. B	229 231	..	4 6 7
523,500	,,	,,	10	Do. C	229–231	..	4 6 7
70,000	10	Oct. 14	6	South African	10¾–11½	..	5 6 8
6,429,895	Stk.	Aug. 12	5/9/4	South Met., 4 p.c. Ord.	121–123	..	4 8 10
1,895,445	,,	July 14	3	Do. 3 p.c. Deb.	80–82	..	3 13 2
209,820	Stk.	Aug. 31	8	South Shields Con. Stk.	155–157	..	5 1 11
605,000	Stk.	Aug. 12	5⅝	S'th Suburb'n Ord. 5 p.c.	120–122	..	4 12 9
60,000	,,	,,	5	Do. 5 p.c. Pref.	120–122	..	4 2 0
117,058	,,	July 14	5	Do. 5 p.c. Deb. Stk.	122–124	..	4 0 8
502,310	Stk.	Nov. 11	5	Southampton Ord.	109–111	..	4 10 1
120,000	Stk.	Aug. 12	7	Tottenham A 5 p.c. and B 3½ p.c.	141–143	..	4 17 11
483,940	,,	,,	5⅜		112–114	..	4 16 6
149,470	,,	June 29	4	Edmonton 4 p.c. Deb.	57–59	..	4 0 0
182,380	10	June 10	8	Tuscan, Ltd.	9–9½	..	8 8 6
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	98–100	..	5 0 0
236,476	Stk.	Aug. 31	5	Tynemouth, 5 p.c. max.	113–115	..	4 6 11
255,636	Stk.	Aug. 31	6⅔	Wands- worth B 3½ p.c. 3p.c. Deb. Stk.	140–142	..	4 15 1
85,766	,,	June 29	3		74–76	..	3 18 11

Prices marked * are "Ex div." † Next dividend will be at this rate.

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Resists 4500° Fahr. Best for GAS-WORKS.
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November, 1910.

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SPECIAL LECTURE COURSES OPEN TO THE PUBLIC.

(*A.*) The Distribution and Uses of Coal Gas.—

A COURSE of 22 Lectures on Wednes- days at Six p.m. and Thursdays at Nine a.m., during Eleven consecutive weeks, as under :—
1911.
Jan. 11 to Feb. 2.—Eight Lectures on "Distribution of Coal Gas," by Mr. Walter Hole, of Leeds.
Feb. 8 to 16.—Four Lectures on "Gaseous Combustion and Structure of Flames," by Professors Bone and Smithells.
Feb. 22 to March 9.—Six Lectures on "The Uses of Coal Gas for Heating Purposes," by Mr. John Bond, of Southport.
March 16 to 24.—Four Lectures on "Gas Lighting and Photometry," by Mr. Jacques Abady, of London.
Fee for the whole Course £1 1s., or 10s. 6d. for a Single Section thereof.

(*B.*) Bye-Product Coking Processes.—
A Course of Eight Lectures on Saturdays at 3.30 p.m. Commencing Jan. 21, 1911, by Mr. Ernest Bury, M.Sc., of the Skinningrove Iron Company, Limited.
Fee for the Course, 10s. 6d.
For further Particulars Apply to the Registrar.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, South Kensington, S.W.,

INCLUDING THE
ROYAL COLLEGE OF SCIENCE,
ROYAL SCHOOL OF MINES, AND
CITY AND GUILDS COLLEGE.

THE Second Part of a Special Course of ADVANCED LECTURES, as follows, will begin during January next :—
Subject :
"GASEOUS FUEL AND COMBUSTION."
Conducted by
Professor W. A. BONE, D.Sc., Ph.D., F.R.S.
Particulars of this, and other Courses to Follow, Free on Application to the Secretary.

LLANDUDNO URBAN DISTRICT COUNCIL.

THE Council invite Tenders for the Supply of Ordinary and Prepayment Dry GAS METERS, size 3 Light and upwards, during a period ending the 31st of March, 1912.
Tenders to be sent in to the undersigned not later than the 31st of December, 1910, endorsed "Meters."
The Council do not undertake to accept the lowest or any Tender.

By order,
(Signed) Alfred Conolly,
Clerk to the Council.

Town Hall, Llandudno,
Dec. 1, 1910.

COUNTY BOROUGH OF SALFORD.

(Gas Department.)

THE Gas Committee invite Tenders for the Supply of RETORTS, FIRE-BRICKS, &c., required at their various works.
Full Particulars may be obtained on Application to Mr. William W. Woodward, Engineer, Gas Offices, Bloom Street, Salford.
Sealed Tenders, endorsed "Tender for Fire-Clay Goods," addressed to the Chairman of the Gas Committee, Town Hall, Salford, to be delivered to me not later than Three p.m. on Thursday, the 15th of December, 1910.

L. C. Evans,
Town Clerk.

Salford.

CORPORATION OF GLASGOW.

(Gas Department.)

GAS STOVES AND GRILLERS.

THE Corporation invite Tenders for the Supply of GAS STOVES and GRILLERS as may be required during the next Two Years.
Forms of Tender may be had on Application to Mr. Alexander Wilson, Gas Engineer, 45, John Street, Glasgow.
Sealed Offers, marked outside "Tender for Stoves, Gas Department," must be lodged with the Subscriber on or before Tuesday, the 27th of December prox.
The lowest or any Tender may not be accepted.

A. W. Myles,
Town Clerk.

City Chambers, Glasgow,
Nov. 30, 1910.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of the Company, so far as they relate to DEBENTURE STOCK, WILL BE CLOSED from the 14th to the 21st of December, 1910, both days inclusive.
The Interest for the Half Year to Dec. 31, 1910, will be payable on the 1st of January to the Proprietors Registered on the closing of the Books.

By order of the Board,
E. Topley,
Secretary.

Chief Offices of the Company :
699, High Road, Tottenham,
Nov. 30, 1910.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to DEBENTURE STOCK and BONDS, WILL BE CLOSED at One o'clock p.m., on Saturday, the 10th prox., for the Half Year ending on the 31st prox., and WILL BE RE-OPENED on the Morning of Monday, the 12th prox.
The Interest for the Half Year will be payable on the 2nd of January next to the Proprietors Registered on the closing of the Books.

By order,
Henry Rayner,
Secretary.

Chief Office : Horseferry Road,
Westminster, S.W., Nov. 28, 1910.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MESSRS. A. & W. RICHARDS beg to notify that their SALES BY AUCTION of NEW CAPITAL ISSUED UNDER PARLIAMENTARY POWERS, and of STOCKS and SHARES belonging to EXECUTORS and other PRIVATE OWNERS in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES, take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.
Terms for Issuing New Capital, and also for including other Gas and Water Stocks and Shares in these Periodical Sales, will be forwarded on Application to Messrs. A. & W. Richards, at 18, Finsbury Circus, E.C.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER,
Gas Engineers' Agents and Contractors for METERS, FIRE-CLAY GOODS, OXIDE OF IRON AND ALL OTHER GAS APPARATUS.
Inquiries Solicited.
Telegrams: "DARWINIAN, MANCHESTER."
Telephone 1806.

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CANDLE SAFETY LAMPS.
Are a great improvement on Oil, giving a good Light, requiring little or no Cleaning, and when once lighted no further attention is necessary. The Candles are made to burn 5, 7, or 9 hours.

43 Manchester Street, Gray's Inn Road, W.C.

COOKE, ENNEVER & TULK,
Stock Brokers,
17 & 18, NEWGATE STREET, E.C., and PRINCE'S CHAMBERS, BIRMINGHAM.
We are Buyers and Sellers by Private Treaty of Stocks, Shares, and Debentures in approved Old Established Water or Gas Undertakings, and make this a speciality. Prices quoted on Application.
New Capital issued, Municipal Loans arranged.
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'Phone City 4660. Tele.: "Bipunctual London."

MIRFIELD GAS COAL.
UNEQUALLED.
Sperm Value 878·85 lbs. per Ton.
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LONDON : 16, Park Village East, N.W.

JAMES OAKES & CO.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.
Manufacture and keep in Stock at their Works (also large Stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
Note.—Makers of HORSLEY SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts, and Covers, and rendering Leakage impossible.

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Makers of Cast-Iron PIPES and CONNECTIONS for Gas, Water, Steam, Electrical, Sanitary, and other purposes; also TANKS, COLUMNS of every description, Hydraulic, Gas, and Colliery PLANT, &c.

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CHAMBER OVENS.

Results obtained which have never been Surpassed by any other System of Carbonization.

Plants at Work and under Construction for the production of **18,000,000** cubic feet of Gas per Day.

See our large Advertisement appearing in alternate issues of the "JOURNAL."

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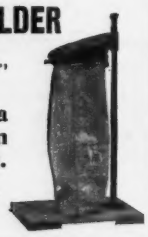
PHŒNIX SACK HOLDER

Made by

RICHARD SIMON & SONS, LTD., NOTTINGHAM,



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Those desiring to obtain **Gas Calorimeters** as used in the **Official Testing Places** should see that the apparatus bears the name of the Original makers.

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STRACHE'S GAS CALORIMETER

measures, through observations on a Pressure Gauge of the increase of Pressure of the Air surrounding an explosion pipette, the heat imparted by the latter to that Air.

It works without Water Supply and Waste-Pipe.

No Preparation required. Readily Portable.

A Test is made in Three to Five Minutes.

Great Exactness.

Suitable also for Suction Gas and Power Gas.

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Stoking Machinery

HYDRAULIC COKE PUSHERS

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[See Illustrated Advertisement, Nov. 8, p. 370.]

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MODERN METHODS OF SAVING LABOUR IN GAS-WORKS

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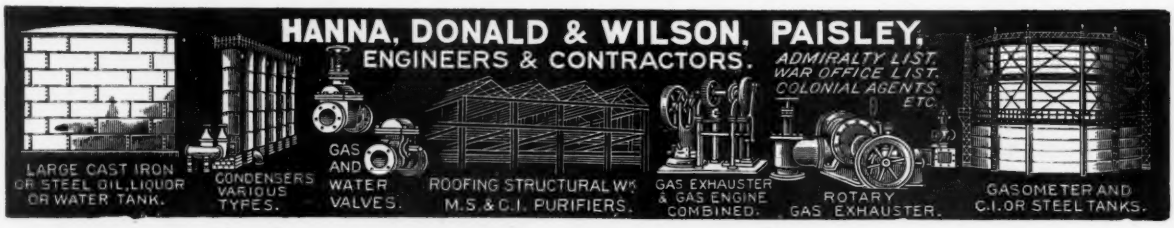
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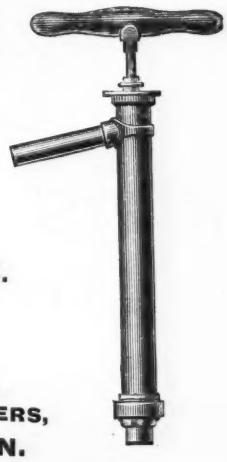

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TOWNS.	No. of Settings.	Coal capacity per 24 hours.	No. of Chambers.
Munich, Kierchstein	5	48·5 Tons	15
Munich, Moosach (1st Order)	6	117 ,,	18
Munich ,, (2nd Order)	6	117 ,,	18
Hamburg, Grassbrook (1st Order)	10	195 ,,	30
Hamburg ,, (2nd Order)	14	310 ,,	42
Berlin, Tegel	27	526 ,,	81
Rome	20	350 Tons	60
Paris, Genevilliers	20	272 ,,	60
Leipsig, Connewitz	8	156 ,,	24
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Regensburg	5	87 ,,	15

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SILICA
"MACHINE MADE" RETORTS

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These retorts are now largely used and proved to be superior to **ANY** fire-clay retort.

Their qualities of not **SHRINKING OR SAGGING** mark their difference from retorts made of fire-clay, and this property of remaining stationary under working conditions places them in a class of their own.

WE GUARANTEE:

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WE CLAIM:

Greater efficiency than any fire-clay retort.

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That carbon does not readily adhere to them, and they are easy to scurf.

That being Machine Made they are even in texture and without joints, and having few, if any, air spaces, the conductivity is superior to any hand-made retort.

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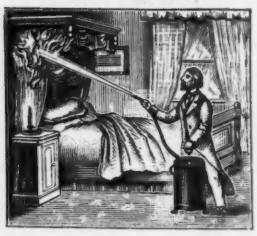

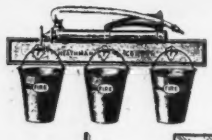

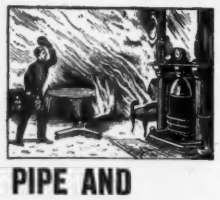

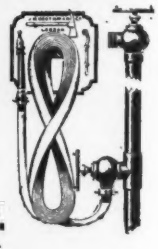

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"LUX"
Gas Purifying Material.

Further Reduction in Cost of Gas Purification.

TRY IT.

Purifier changes are less by over one-half when using "LUX" as compared with Bog Ore, and it requires considerably less turning than Bog Ore for revivification.

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GAS REGULATION on the TOP of the LAMP.

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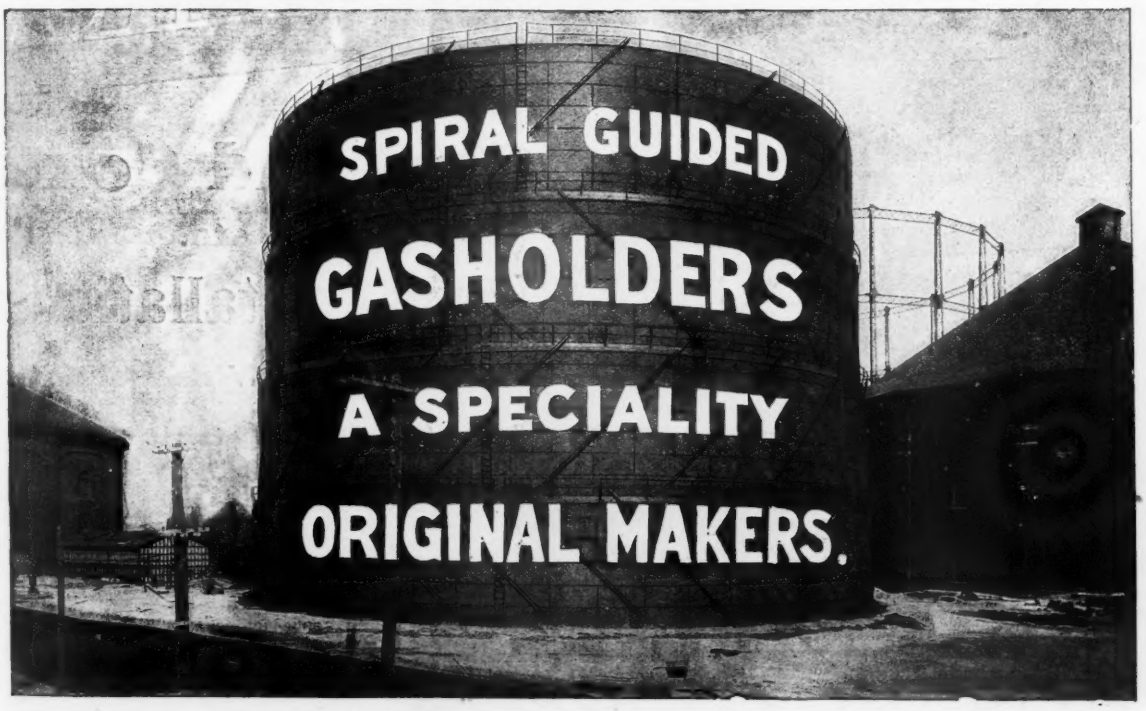
Makers of the First Spiral Guided Holder (1889).



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For Terms, apply to COALEXLD LIMITED, LANCASTER.

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SIMMANCE-ABADY
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No Liquid.
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Very Sensitive.
Weighs 8 lbs.

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NAPHTHALENE SOLVENT.

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THE FINEST NAPHTHALENE SOLVENT.
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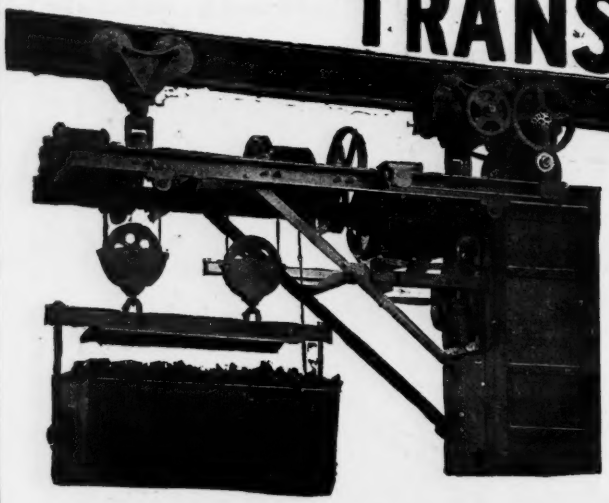

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Large Installations
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at work and
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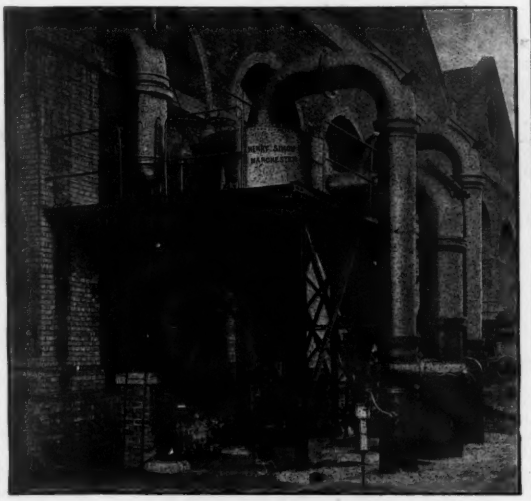

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No Steam.
No Moving Parts.
No Power.

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OF ANY MAGNITUDE
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The SMALLEST 3-Light Cluster Lamp. Height over all, 18½ ins. Diameter, 9 ins.

300-CANDLE POWER,
Minimum
Consumption.

No Inner Glass or Chimneys.

For Shops, Lobbies, Warehouses, &c.

Made in Steel and Copper, Bronze or Polished Brass.

9 CUB. FT. PER HOUR.
Maximum Light.

Brilliant, Shadowless, and Simple.

Excellent Quality and Finish.

Nothing to get out of Order.

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SELF-INTENSIVE HIGH-POWER LAMP
Is the Best Proof of its Usefulness.

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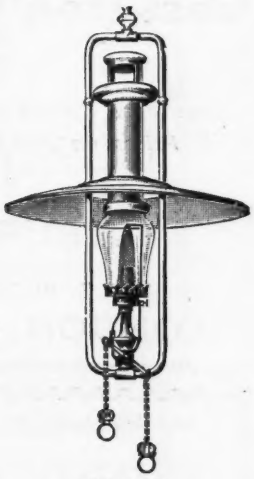

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ABSOLUTELY WIND, DUST, AND INSECT PROOF
200, 400, and 700-Candle Power from a Single Mantle,
with Gas at its usual Pressure, and Lowest consumption on record.

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Adopted in:—
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Ornamental Square & Round Cast-Iron Cases.

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LATEST DESIGN.

MOBBERLEY & PERRY OF STOURBRIDGE
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are now manufacturing (in addition to their ordinary "Best Stourbridge Quality") a specially High-Class Grade of Retort "BEST BRITISH" (B.B.) which for high temperatures and endurance cannot be excelled.

Welsbach LIGHT

Inverted Arc Lamp, Fig. 623.

Storm Proof—

For Exterior Lighting.

Welsbach-Kern

(Patent) Inverted System

BRITISH MADE.

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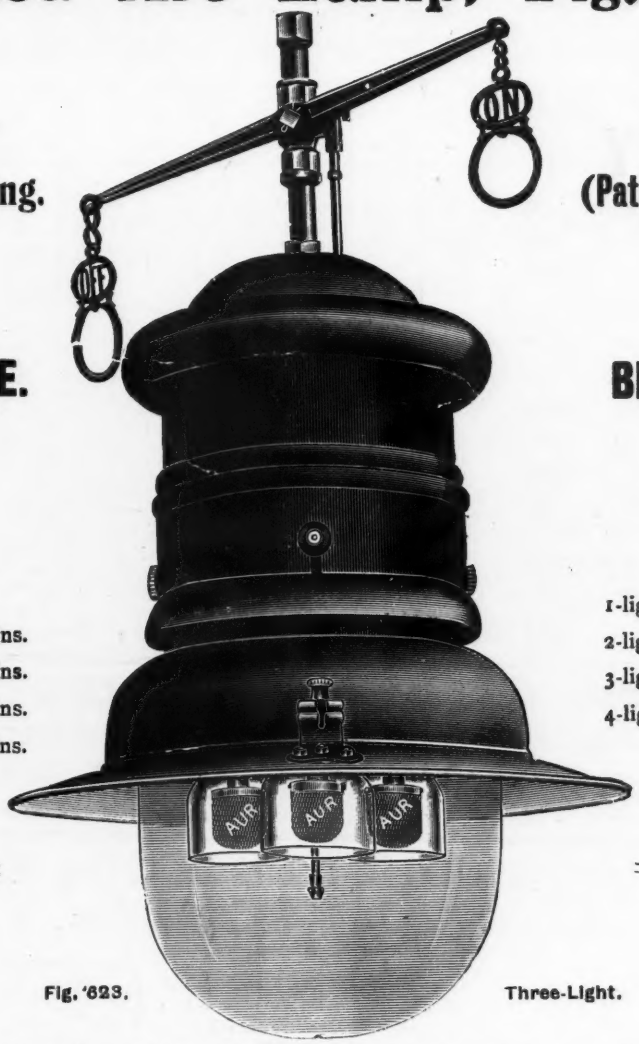

Fig. 623. Three-Light.

Height over all.

1-light . . .	1 ft. 8 ins.
2-light . . .	2 ft. 4 ins.
3-light . . .	2 ft. 4 ins.
4-light . . .	2 ft. 7 ins.

Width over all.

1-light . . .	1 ft. 1 in.
2-light . . .	1 ft. 5 ins.
3-light . . .	1 ft. 5 ins.
4-light . . .	1 ft. 8 ins.

ENAMELLED Green Steel Casing, fitted with Welsbach-Kern Inverted Burners, Gas and Air Regulators operated from outside. Sliding Door to give access to Burners for cleaning purposes. Fitted with Magnesia Nozzles, Welsbach Mantles, and Glass Mantle Protectors. Complete as shown. Highly efficient and regenerative.

	Gas per hour.	*C.P.*	*Steel.*	*Copper Case.*
1-light	4 feet	125	**30/-**	**5/-** extra.
2-light	8 feet	260	**47/6**	**6/-** extra.
3-light	12 feet	400	**52/6**	**6/-** extra.
4-light	16 feet	550	**72/6**	**9/-** extra.

All on or off, or One light on and the rest off, **7/6** per Lamp extra. Cup and Ball, **3/6** per Lamp extra.

RENEWALS.

Glass Mantle Protectors (Fig. 623) **3/4½** per dozen, or in case lots of 5 gross, **33/-** per gross.

	1-Light.	*2-Light.*	*3-Light.*	*4-Light.*
Clear Glass Globes, each	**2/3**	**5/9**	**5/9**	**9/-**
" " " In Case lots per dozen.	**19/6**	**57/9**	**57/9**	**93/-**
Case contains . .	*80*	*18*	*18*	*12*

	1-Light.	*2-Light.*	*3-Light.*	*4-Light.*
Wired Globes, extra each	**2/-**	**2/-**	**2/9**	**3/6**
Parabolic Reflector, extra "	**3/6**	**6/-**	**7/6**	Not made

Welsbach Mantles, **4½d.** each, or **4s. 3d.** per dozen subject as usual.

The Welsbach Mantles for Upright lighting are "C," "CX," and "Plaissetty," price **4½d.** each.

THE WELSBACH INCANDESCENT GAS LIGHT CO., LTD.,

Welsbach House, 344-354, Gray's Inn Road, London, W.C.

Telegrams and Cables: "WELSBACH LONDON." *Telephone* 2410 NORTH.

B. GIBBONS, JUNR., Ltd.

LONDON:
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The largest Manufacturers of
GAS RETORTS
(Horizontal, Inclined, and Vertical)
IN THE WORLD.

MANCHESTER:
85, Trevelyan Buildings,
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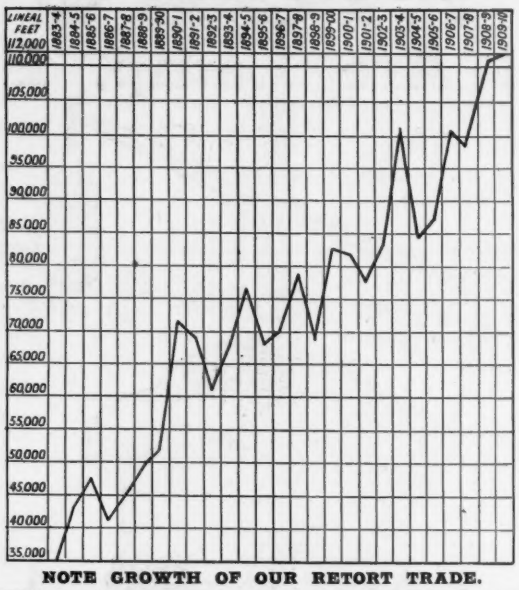
We shall place on the market an Improved Retort

ONE QUALITY ONLY

at a slight advance in price, and guarantee it second to no other make either at home or abroad.



NOTE GROWTH OF OUR RETORT TRADE.

1911.

We shall place on the market an Improved Retort

ONE QUALITY ONLY

at a slight advance in price, and guarantee it second to no other make either at home or abroad.

COLONIAL FRIENDS

We have for many years enjoyed the support of our Colonial Friends, and we look forward to their continued confidence.

PLEASE NOTE.

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HEAD OFFICE: DIBDALE WORKS, DUDLEY, ENG.

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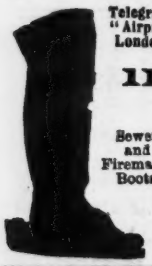
Wet and Dry Gas Meter Manufacturer.

PREPAYMENT METERS for Pennies, Shillings, or any other Coin.

Sole Agent for Scotland: DANIEL MACFIE, 1, North St. Andrew Street, EDINBURGH.



Telegrams: "Airproof, London."

THOMAS BUGDEN & CO.,

Telephone: 743 City.

India-Rubber and Airproof Manufacturers and General Contractors,

116-118, GOSWELL ROAD, LONDON, E.C.

Largest Manufacturers of Gas Main Bags.

Sewer and Fireman's Boots.

Gas Bags for repairing Mains. All Seams Stitched and Taped.

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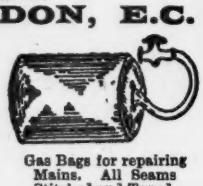
Impervious to Main Liquor and Climatic Influences.

Oilskin Clothing, Diving and Wading Dresses, Sewer Boots, Tar Hose, Stokers' Mitts, Bellows, &c.



Gas Bags for repairing Mains. All Seams Stitched and Taped.

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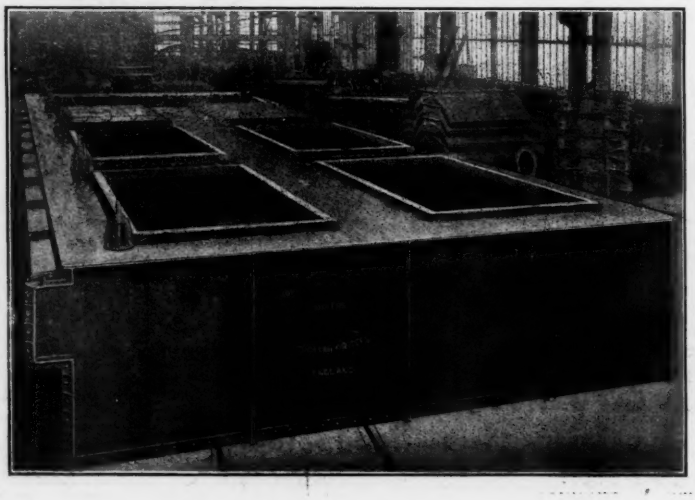

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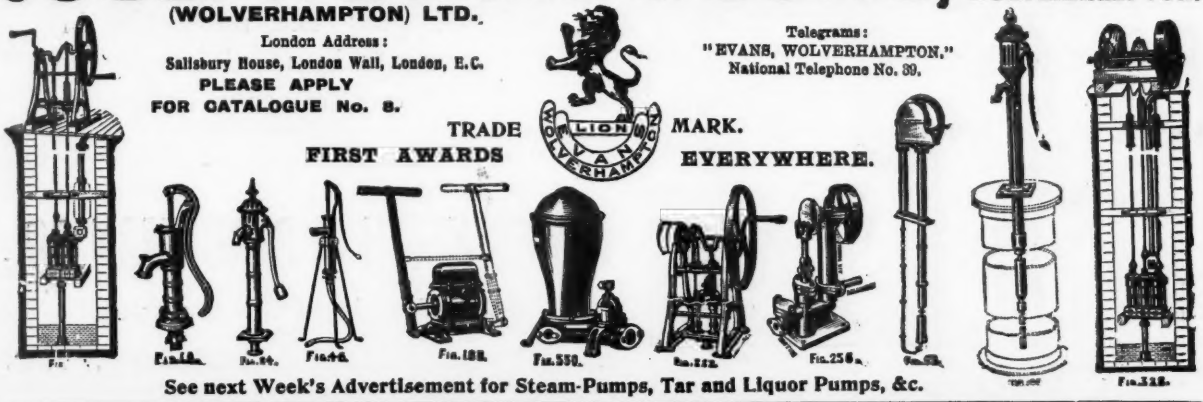

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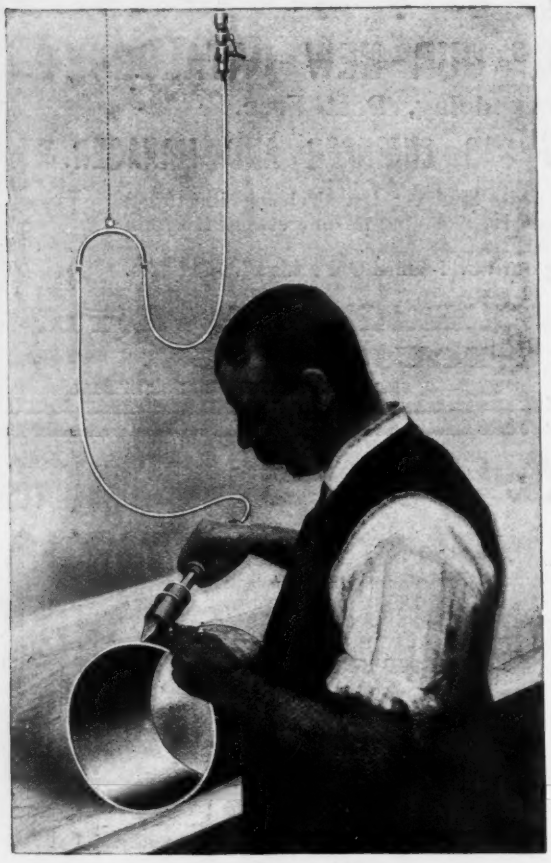

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Perfect air regulation.

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Solid Copper Bit renewable in few moments by the loosening of one set screw.

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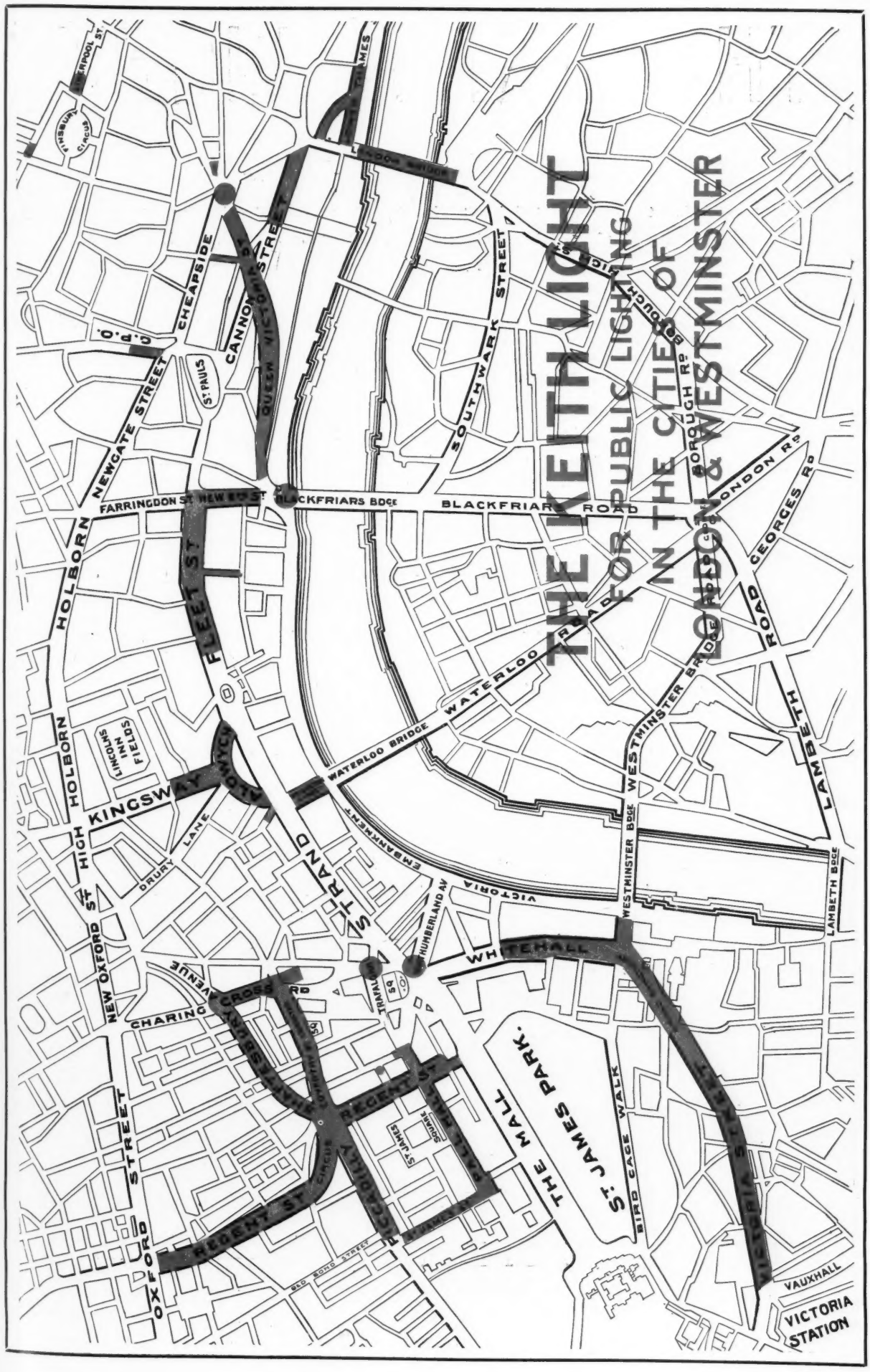
THE KEITH LIGHT
FOR PUBLIC LIGHTING
IN THE CITIES OF
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CHEAPSIDE
CANNON STREET
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THE KEITH LIGHT.

ALL those interested in Public Lighting should take the earliest opportunity of inspecting the "KEITH" Lamps in the Cities of London and Westminster.

UNEQUALLED BY ANY OTHER FORM OF ARTIFICIAL LIGHT.

In Cannon Street the Lamps have two burners, and are suspended centrally over the roadway by means of overhead wires with lowering-gear attached, so that the Lamps can be drawn to the side and lowered.

SUITABLE FOR ALL CLASSES OF LIGHTING.

Fleet Street is lighted by Lamps of the single-burner type, chiefly suspended from Brackets over the pavement. New Bridge Street also has single-burner Lamps, but fixed on Columns.

LAMPS MADE IN GREAT VARIETY, GIVING FROM 60 TO 4,500 C.P.

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